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STATE OF MONTANA  
TELECOMMUNICATIONS NETWORK  
PROJECT FEASIBILITY ANALYSIS  
REPORT AND RECOMMENDATIONS

VOLUME 2

APPENDICES

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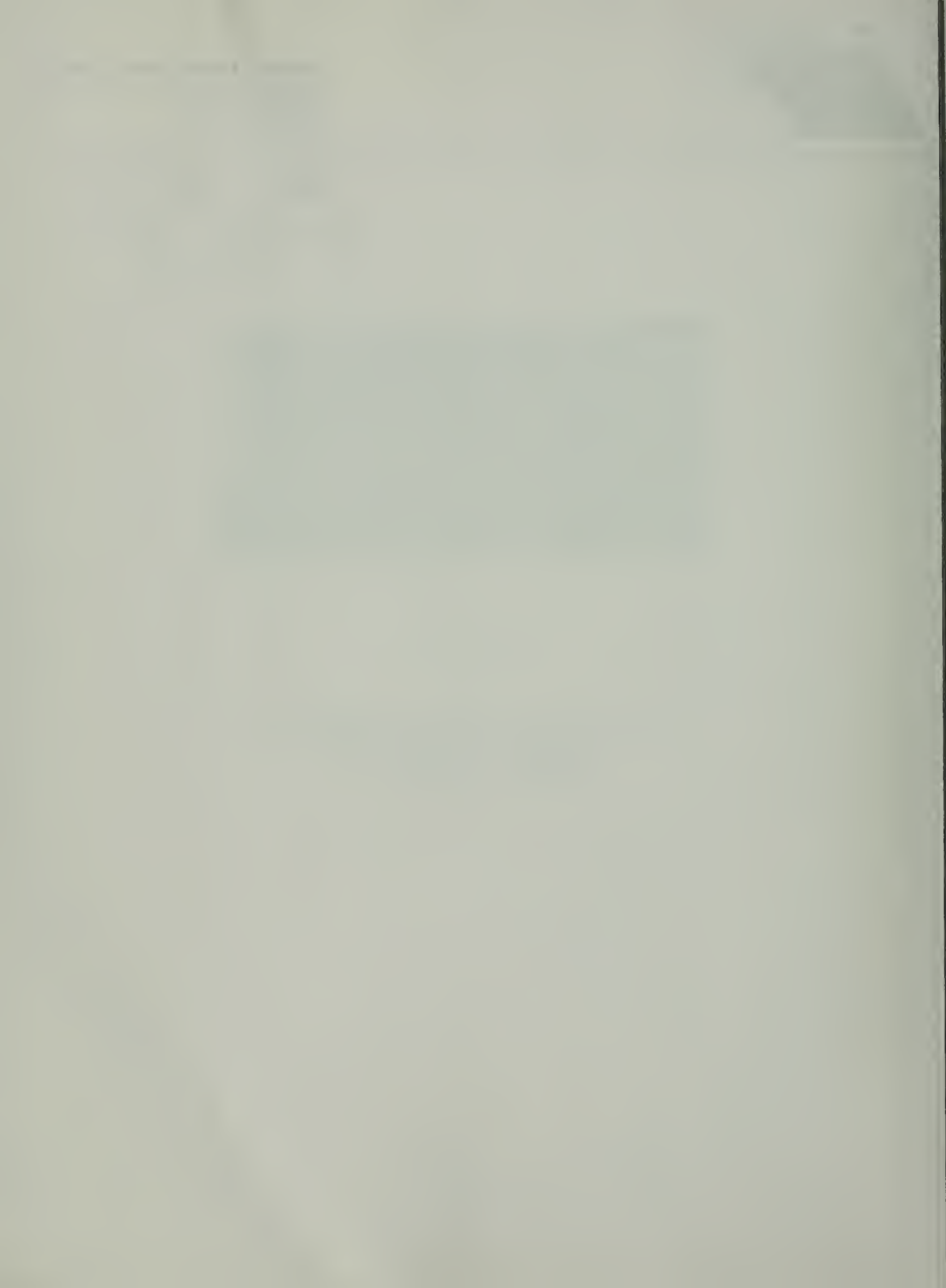
STATE OF MONTANA  
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VOLUME 2

APPENDICES

March 1986

Prepared for the Telecommunications Bureau  
Information Services Division  
Department of Administration  
State of Montana



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APPENDIX A

TELECOMMUNICATION POLICY ADVISORY COUNCIL

(TPAC)



**TELECOMMUNICATIONS POLICY ADVISORY COUNCIL**  
**Member List**

Rep. Joe Quilici  
Chairman  
3040 Kossuth  
Butte, MT 59701

Sen. George McCallum  
Box 262  
Plains, MT 59859

Gen. James W. Duffy  
Dept. of Military Affairs  
1100 N. Last Chance Gulch  
Helena, MT 59620

Ardith Aiken, Commissioner  
Great Falls City Commission  
P.O. Box 5021  
Great Falls, MT 59403

William J. Lannan  
University System  
33 S. Last Chance Gulch  
Helena, MT 59601

Daniel Dolan  
Office of Public Instruct.  
Helena, MT 59620

Sen. Dick Manning  
Vice Chairman  
810 Seventh Ave. No.  
Great Falls, MT 59401

Dave Wanzenried, Commissioner  
Department of Labor & Industry  
Helena, MT 59620

Rep. Earl Lory  
4795 Miller Creek Rd.  
Missoula, MT 59803

Gordon Browder, Chairman  
Board of Crime Control  
2309 Cloverdale  
Missoula, MT 59801

Sara Parker  
State Librarian  
Helena, MT 59620

Lyle Stortz, County Commissioner  
Musselshell County  
P.O. Box 686  
Roundup, MT 59702







## APPENDIX B

### USER INTERVIEWS



## INTERVIEW RECORD

Person Interviewed:

Date:

Organization:

Number of Employees in Organization:

Type of Service:    Voice \_\_\_\_ Data \_\_\_\_ Other \_\_\_\_

Is present service adequate for needs of organization?

Are there any expected changes in the organization?

Change in size in percentage:

More or less centralization:

Change in technical requirements:

Data

Video

Facsimile

Mobile Radio

Remote Sensing

Roadside Emergency Phones

Highway Telemetry

Is there a disaster recovery responsibility within the organization?

Has organization used the teleconferencing facility?

Would a video conferencing capability be used?

Interviewer:



## AGENCIES INTERVIEWED

Department of Administration  
Department of Agriculture  
Montana Arts Council  
State Auditor's Office  
Office of Budget and Program Planning  
Department of Commerce  
Department of Fish, Wildlife and Parks  
Governor's Office  
Department of Health and Environmental Sciences  
Department of Highways  
Montana Historical Society  
Department of Institutions  
Department of Justice  
Department of Labor and Industry  
Department of State Lands  
Legislative Council  
Legislative Fiscal Analyst  
State Library  
Department of Livestock  
Department of Military Affairs  
Department of Natural Resources and Conservation  
Office of Public Instruction  
Public Service Commission  
Department of Revenue  
Secretary of State  
Department of Social and Rehabilitation Services

Supreme Court

Montana University System

Eastern Montana College

Montana College of Mineral Science and Technology, Butte

Earthquake Studies Office, Montana Bureau of Mines  
and Geology

Montana State University

University of Montana

Northern Montana College

Miles Community College

## DEPARTMENT OF ADMINISTRATION

### VOICE

- Voice service is meeting needs

### DATA

- Activities of divisions of the Department of Administration are vital to the work of other State agencies. All are interdependent with, e.g.,

- Purchasing
- Architecture and Engineering
- Treasury
- Information Services
- Publications and Graphics

- Interested in machine readable and electronically indexed

- Administrative Rules of Montana
- Personnel policies
- Operations manual

- Electronic mail and calendaring can improve communications, reduce use of paper and photocopy

Interviewed: Ellen Feaver, Director  
Dave Ashley, Deputy Director

## DEPARTMENT OF AGRICULTURE

### VOICE

- Voice service is meeting needs
- Teleconferencing supports some Board meetings

### DATA

- Eight personal computers in the Scott Hart Building share access to a disk memory
- Personal computers are being installed in the district offices; hope to add communications capabilities
- The U. S. Department of Agriculture is encouraging the use of electronic mail in communication with their offices
- Access on-line databases, e.g., a pesticide database at Purdue University in Indiana

98 employees, plus 20 additional in summer

Interviewed: Ralph Peck, Deputy Director

## MONTANA ARTS COUNCIL

### VOICE

- Voice service is meeting needs

### DATA

- Linked into 10-state ARTSNET, supported by the Western States Arts Foundation, based in Santa Fe
- Seeking ways that communications technology can help in linking Montana's high proportion of artists with one another, and with their markets.
- Building coalitions of arts organizations

Interviewed: David Nelson, Director  
Bill Pratt, Organizational Services Director

## STATE AUDITOR'S OFFICE

### VOICE

- Voice service is meeting needs

### DATA

- The office is responsible for
  - Payroll and Warrant writing
  - Insurance activities within Montana
  - Securities activity within Montana
- An office automation project is now underway
- Payroll now operates as a batch processing system in the main-frame; working toward direct on-line terminal processing by the agencies instead of current paper forms for input.
- In insurance and securities, working toward electronic on-line report filing -- both by companies to State, and State to national databases

Interviewed: Dick Gilbert, Deputy Auditor  
Richard Hall

## OFFICE OF BUDGET AND PROGRAM PLANNING

### VOICE

- Voice service is meeting needs

### DATA

- As other departments and agencies carry forward their automation projects, OBPP may have easier and more direct access to information
- Dependent to a large degree on efforts other agencies make in getting budget planning information into machine-readable form

Interviewed: Dave Hunter, Director  
Doug Booker, Budget Office

## DEPARTMENT OF COMMERCE

### VOICE

- Voice service is meeting needs

### DATA

- Currently have direct terminal access to mainframe
- Investigating a minicomputer system to support a departmental management system
- Local government relations responsibilities include:
  - Pass-through grants
  - Auditing functions
  - Technical assistance
  - Housing programs
- Some local government would like to provide report data on-line, and this is a direction for the future
- Lieutenant Governor Turman directed a project to support better information exchange between local governments and state government

260 employees in Helena

Interviewed: Keith Colbo, Director  
Andy Poole  
Alene Gorecki

DEPARTMENT OF FISH, WILDLIFE AND PARKS

VOICE

- Voice service is meeting needs

DATA

- Developing a plan to provide data links from seven regional offices with Helena
- Interested in electronic mail
- Foresee development of databases for
  - License Drawing
  - Violators
- In dealing with violators, it would be useful also to have access to Motor Vehicle and Drivers License databases
- Research laboratory in Bozeman is making increasing use of national databases

Approximately 400 employees: 75 in Helena, 70 in 7 Regional Offices; Wardens working out of homes; Fisheries & Biologists

Interviewed: Sharon Garden, Centralized Services Division  
Jim Hermann, License Bureau

## GOVERNOR'S OFFICE

### VOICE

- Voice service is meeting needs

### EMERGENCY COMMUNICATIONS

- Governor requires the ability to communicate while in transit within the State; important that the Governor can receive or send critical messages, wherever he is in Montana
- Requires the ability to communicate with the area in the event of a disaster or emergency anywhere in the State
- Requires communications into the broadcast media to reach the public quickly and effectively in the event of an emergency

Interviewed: Ted Schwinden, Governor

## DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

### VOICE

- Voice communications is meeting needs
- Considerable voice communications with local health authorities

### DATA

- Considerable exchange of information and reporting with Federal agencies; 85% of department budget is from Federal funds, largely earmarked.
- Federal priorities change; considerable emphasis now on toxic waste problems and on AIDS

### RADIO

- Concern expressed about need for better coordination of emergency radio needs -- for emergency medical services and for disaster coordination

Interviewed: John Drynan, MD, Director  
Bill Opitz, Deputy Director

## DEPARTMENT OF HIGHWAYS

### VOICE

- Voice service is meeting needs

### DATA

- Eleven district and area offices now have IBM System 1 computers
- A Digital Equipment Company VAX computer with a package for Computer-Assisted Design (CAD) has been implemented in Helena Headquarters. Eventually would like to make this capabilities accessible to highway project managers around the state
- Data is now exchanged, some by facsimile, for payroll and personnel information with field offices
- Already 30+ personal computers in the headquarters building, and more coming. Experiencing reduced response time in links with the Mitchell Building mainframe

### RADIO

- Converted to high band radio
- Coordinating dispatch with the Highway Patrol

1800 employees, all across the State

Interviewed: John Prebil, Deputy Director  
Ron Haraseth, Manager Communications  
Mike Randall, Systems and Programming

## MONTANA HISTORICAL SOCIETY

### VOICE

- Voice service is meeting needs
- Respond by telephone to growing number of research inquiries

### DATA

- Project is underway with links to a nationwide database, to catalog the holdings of Montana newspapers, and thus make them more accessible to researchers
- Direct telephone line for typesetting MONTANA magazine
- Possible future links to subscription fulfillment service database in Ohio for MONTANA magazine
- Increasing use of dial-up data access; e.g., to database in Missoula of archeological site information

52 employees in Helena, including 7 at separate Historic Preservation office

Interviewed: Robert Archibald, Director  
Brian Cockhill, Administration, Centralized Services

## DEPARTMENT OF INSTITUTIONS

### VOICE

- Voice service is meeting needs
- Because of the wide distribution of institutions and staffs having 24 hour/day responsibilities, while management is based in Helena, effective communication links are critical

### DATA

- The Department is establishing a communications network linked to its own IBM System 38
- Applications to be supported will include:
  - Caseload Management
    - for Corrections
      - including both
        - institutional clients, and
        - outside clients
    - for Mental Health

2300 employees, including 170 in Helena

Interviewed: Curt Chisholm, Deputy Director

## DEPARTMENT OF JUSTICE

### VOICE

- Voice service is meeting needs

### DATA

- Criminal Justice Information Network (CJIN) now supports 80+ terminals in 50 counties, available 24 hours per day
- Use of CJIN is growing rapidly
- Provides direct gateway to FBI files
- CJIN availability is critical, thus a remote back-up system and redundant circuit links are high priority

### RADIO

- Working to better integrate the radio network, to improve officer dispatching
- Seeking to improve use of mutual aid frequencies
- Would like a capability to issue an "All Points Bulletin" state-wide

Interviewed: Susan Hansen  
Gerry Rymes  
Robert Landon  
Dutch Meyers

## DEPARTMENT OF LABOR AND INDUSTRY

### VOICE

- Voice service is meeting needs

### DATA

- Automated systems already in place include:
  - Job matching system for Job Service office
  - Benefits automation project for Workers Compensation
- Implementing electronic mail system to link 28 sites
- Pursuing further automation of central office functions, including link to Workers Compensation Building
- Department administrators Statewide Occupational Information Coordinating Committee (SOICC) activity
- The Montana Career Information System (MCIS) is administered under the Department
- Considerable exchange of information with the U. S. Bureau of Labor Statistics

750 employees

Interviewed: Dave Wanzenried, Commissioner  
Rod Sager, Administrator, Centralized Services Division  
Roy Hickman, Data Processing Manager  
Larry DeFrance, Systems Analyst

## DEPARTMENT OF STATE LANDS

### VOICE

- Voice service is meeting needs

### DATA

- Area offices have computers, and data communications needs are increasing
- Bringing a "Trust Land Management System" on line; area offices will want access to this
- Seeking better information dissemination capabilities to field offices

### RADIO

- Have extensive mobile radio use -- especially in meeting fire-fighting needs
- Considerable coordination with the U.S. Forest Service, and with other agencies of government

265 employees, including 80 in Helena and 50 in Missoula (approximately 400 in summer)

Interviewed: Dennis Hemmer, Commissioner

## LEGISLATIVE COUNCIL

### VOICE

- Voice service is meeting needs

### DATA

- Heavy use of data links within the Capitol building
- Heavy text composition and printing needs during the Legislative Session; print 40,000-50,000 pages per year
  - Reports
  - Minutes
  - Bill drafting
- Bill status system is accessed on-line by users outside the Capitol
- Batch update of bill status database allows multiple search

44 employees (110 during the Legislative Session)

Interviewed: Lee Heiman

## LEGISLATIVE FISCAL ANALYST

### VOICE

- Voice Service is meeting needs

### DATA

- Office has three terminals linked to the Central Data Center mainframe to support the Legislative Interactive Budgeting system
- Interested in electronic mail; would be particularly valuable during the budget analysis period
- Make use of the National Council of State Legislators database, by dialing up the system based in Denver
- Subscribe to econometrics database

Interviewed: Jim Haubein  
Keith Wolcott

## STATE LIBRARY

### VOICE

- Voice service is meeting needs
- Use the teleconference capability for some meetings

### DATA

- Now implementing a Natural Resource Information System based at the State Library
- Will provide on-line access or answers to telephone inquiries
- A number of Montana public and academic libraries share in the Western Library Network (WLN), based in the state of Washington. There are significant telecommunications costs, and the library community is interested in shared network approaches to providing these links
- The State Library is funded now to provide searches of information databases; it is desired that such searches not become fee-based
- More direct home delivery of library materials is foreseen over time

640 libraries in Montana

Interviewed: Sara Parker, State Librarian  
Sheila Cates, Coordinator of Library Services

## DEPARTMENT OF LIVESTOCK

### VOICE

- Voice service is meeting needs.

### DATA

- Maintain a Brands database, identifying over 65,000 brands; would like to make this available on-line to inspectors in major cattle markets.
- Certain livestock diseases are required to be reported to the State Veterinarian "by the fastest means possible" to avoid spread; better telecommunications links can support such reporting.
- Access Federal Brucellosis Information database, and other USDA information.
- Access file of information on ranch and farm mortgages.

### RADIO

- Inspectors have high band radios; work with sheriff's offices and highway department in communications.

Interviewed: John Skufca, Centralized Services Division  
Donald Ferlicka, DVM, State Veterinarian  
Lorrane Dressler, Purchasing and Supply Officer

## DEPARTMENT OF MILITARY AFFAIRS

### VOICE

- Have OPX line to Bozeman for connection with Autovon network
- OPX links also with Fort Harrison and Helena Airport

### DATA

- Backup mainframe computer being moved from Mitchell Building to Armory
- New telecommunications links required between Armory and Mitchell Building to interconnect the computers
- Military Affairs has minicomputer systems in Helena Armory and in Bozeman
- Approximately 65% of military operations are based at Fort Harrison, where Federal government has a Burroughs computer
- Disaster and Emergency Services operates with Military Affairs and has satellite link with the Federal Emergency Management Administration (FEMA) communications

### RADIO

- Operates SECURE radio system, linking Military Affairs and DES people in counties for use in emergencies

100 people in Department of Military Affairs;  
approximately 750 including National Guard.

Interviewed: Maj. Ken Cottrill, Administrator, Centralized Services

## DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

### VOICE

- Voice service is meeting needs
- Teleconferencing capability used for some Board meetings
  - Board of Natural Resources
  - Board of Water Well Contractors
  - Board of Oil and Gas

### DATA

- Maintain a Water Rights database in Helena, accessed by Helena people, by the Water Courts people in Bozeman, and by the Billings Water Rights Office
- Oil and Gas office in Billings developing computer applications
- Increased use also of other databases outside Montana through dial-up use

250 employees, with 180 in Helena

Interviewed: John Armstrong, Administrator, Centralized Services  
George Cawlfild  
Jerry Smith

## OFFICE OF PUBLIC INSTRUCTION

### VOICE

- Voice service is meeting needs

### DATA

- Developing a "Bulletin Board", providing on-line access for message switching and for exchange of public domain software
- Access EDLINE supported by the Association of Chief State Education Officers
- Other national data base services are used, both by OPI personnel and, with their assistance, by school district personnel, such as
  - ERIC
  - SPECIALNET
  - AGNET
  - VOCNET
  - COMPUSERVE

### OTHER

- Interested in capabilities of video teleconferencing for instruction and other purposes; Helena Audio-Visual Center now receives such programs

130 in Helena, 56 County Systems, 551 School Districts

Interviewed: Ed Argenbright, Superintendent  
Bill Anderson, Deputy Superintendent  
Dan Dolan, Mathematics and Computer Education Specialist

## PUBLIC SERVICE COMMISSION

### VOICE

- Voice service is meeting needs
- Considering an In-WATS number for consumer access

### DATA

- Have a data link to the Data Center in the Mitchell Building
- Acquiring additional IBM PC's and more data links
- An IBM System 36 will support
  - Registration of motor carriers (now 6000+ in the database)
- Interested in ability to accept and process machine readable data from the utilities

40 Employees

Interviewed: Madeline Cottrill, Administrator, Centralized Services Div.  
Wayne Budt, Administrator, Transportation Division  
Dan Elliott, Administrator, Utility Division

## DEPARTMENT OF REVENUE

### VOICE

- Voice service is meeting needs

### DATA

- A number of data processing projects now underway have communications implications:
  - Child Support Enforcement offices have personal computers and communications links
  - Property Assessment function is being automated; databases in some cases shared with the counties
  - Moving toward enabling some state accounting firms to file corporate tax returns on-line
  - Terminals in Helena support system for Motor Fuels taxes
  - A major rewrite of the Tax Code is being developed and edited in machine-readable form

1036 employees

Interviewed: Jack Ellery, Deputy Director  
Brenda Haseman

## SECRETARY OF STATE

### VOICE

- Voice service is meeting needs
- Respond to inquiries, e.g., on corporation registration

### DATA

- Developing an automated system for the Uniform Commercial Code (UCC)
- May later develop a comparable system for corporation registration information
- Considering the provision of on-line access, provided initially to the State's larger law firms and banks
- SB124 requires that public access be provided to information on agricultural liens
- In the longer term, considering automated voter registration files -- with possible links to county clerk's offices

35 employees, all in Helena

Interviewed: Larry Akey, Executive Assistant

## DEPARTMENT OF SOCIAL AND REHABILITATION SERVICES

### VOICE

- Voice services are meeting needs

### DATA

- The need for SRS operations is in inverse proportion to the State of Montana's economy
- The Department has assumed operational responsibility for the thirteen largest county SRS offices
- In forty other counties, the State and counties operate with shared funding
- Because of these county-based responsibilities, a large number of reports and updates are being exchanged
- Now working with an IBM Applications Transfer Team toward implementing on-line database systems for:
  - Vocational Rehabilitation
  - Developmental Disability
  - Contracting System for Economic Assistance
- The income maintenance programs now support 8000+ families in Montana, to provide Aid to Families with Dependent Children and Medicare payments
- This provides payments to more people than the State payroll system
- In determining eligibility, it would be useful for SRS to be able to access:
  - Job Service files
  - Property Assessment files
  - Motor Vehicle files

1100 employees, including offices in all 56 counties

Interviewed: Ben Johns, Deputy Director  
Pat Godbout, Administrator, Audit and Program  
Compliance Division

## SUPREME COURT

### VOICE

- Voice service is meeting needs
- Conferencing capability may better support assignment by Justices to District Judges

### DATA

- Increasing use in Helena of IBM 5520 word processing system; used by the Court Justice's offices, the Law Library, and the Clerk of the Court
- Inputs of information are increasingly on standardized forms, with a view toward further data processing applications
- Law Library provides dial-up access to WEST LAW and other on-line databases
- Interested in direct update to personnel files and SBAS

40 employees, all in Helena

Interviewed: Mike Abley, Administrator

## MONTANA UNIVERSITY SYSTEM

### VOICE

- Interested in exploring student access to the State's network
- Would like more detailed telephone accounting capabilities on the campuses
- Making increasing use of teleconferencing for meetings

### DATA

- Campuses are acquiring new mainframe computers, and pursuing improved telecommunications linkages among them to support
  - Access from one campus to computing facilities at another
  - Exchange of programs and files
  - Consolidation of student enrollment information and accounting data for system-wide use
- Establishing link to Guaranteed Student Loan processing center in Indianapolis, and perhaps links to Montana banks.
- Interested in improving links and lowering telecommunications costs for campus library use of the Western Library Network (WLN), based in Washington State.

### OTHER

- Regents have recommended increased multi-campus cooperation on extended education and other programs, which can be supported through telecommunications
- Television capabilities for inter-campus and off-campus instruction, and for cultural programs, is being explored

Interviewed: Bill Lannan  
Paul Dunham  
Jack Noble

## EASTERN MONTANA COLLEGE

### VOICE

- Voice service is meeting needs

### OTHER

- Campus will acquire new DEC VAX computers
- KEMC Public radio on important service to the Billings community

Interviewed: Donald Fox, Budget Office  
Kenneth Heikes, Administrative Vice President  
Edward Neroda, Library Director  
Jack Hull, Computer Center  
Kenneth Woosley, Director of News and Media

MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY, BUTTE

VOICE

- Interested in more detailed telephone accounting capabilities for the campus

DATA

- Using link to Helena mainframe for SBAS
- Have interest in improved exchange of information for personnel and payroll
- Developing a Ground Water Information database on the campus, which will be accessed from other sites
- Increasing use of the campus Computer Center from both on and off-campus -- by
  - Students
  - Faculty
  - School districts
  - Research center

Interviewed: Victor Burt, Director of Fiscal Affairs

EARTHQUAKE STUDIES OFFICE, MONTANA BUREAU OF MINES AND GEOLOGY

NEEDS

- Currently gathers seismic activity information from sites in Southwestern Montana, to record it graphically on equipment in Butte.
- Analog information is carried by low power FM radio to a receiver site outside Butte.
- Functions well spring, summer and fall; but icing on receiver radio antenna renders data unintelligible in winter.
- Interested in any alternatives providing improvement.

Interviewed: Mike Stickney, Director

## MONTANA STATE UNIVERSITY

### VOICE

- Voice service is meeting needs
- Concerned about slow response time with CMC Directory system terminals
- Cited problems in account code billing
- Interested in more detailed telephone accounting capability for the campus

### OTHER

- Interested in establishing quarterly meetings among Universities and the Bureau
- Urge a planning effort to focus public/educational broadcast telecommunications activity in Montana

Interviewed: Marilyn Wessel, Director of Communications  
Craig Roloff, Director, Administrative Services  
Edward Groenhout, Dean, Art and Architecture  
Noreen Alldredge, Dean of Library  
William Moore, Director of Computing Services

## UNIVERSITY OF MONTANA

### VOICE

- Interested in more detailed telephone accounting capability for the campus
- Problems in using voice grade lines linked on-the-air to KUFM

### DATA

- A new DEC VAX 8600 computer will be brought up in December, and a second will be brought on line, with the two coupled as a cluster
- With these additional capabilities, many more campus terminals can be supported (500-600 concurrently); the campus is interested in exploring whether these terminals might be linked through the present telephone system wiring
- With MBA program operating in Billings, expect much telecommunications activity to the Missoula computer
- Foresee much more sharing of information, data, files and programs among the campuses, and with the System administrator

### OTHER

- Interested occasionally in satellite or terrestrial links from the campus to broadcast television stations across the State -- to feed programming such as former President Carter's visit next spring.
- University is affiliated with the National University Teleconferencing Network, which currently provides for reception and campus use of instructional programming
- The campus Instructional Materials Center can receive, distribute and/or record and retain educational programming delivered via satellite

Interviewed: Leonard Lewis, Data Processing Manager  
Steve Henry, Computer Center Manager  
Ken Fielding, Director, Telecommunications

## NORTHERN MONTANA COLLEGE

### VOICE

- Pleased with new SL1 system, installed in August, 1985
- Campus employee is trained to handle telephone moves, adds and changes; working well

### OTHER

- Have installed a DEC VAX computer with a number of campus terminals
- Grant application made to NTIA U.S. Department of Commerce, to establish public radio and public television facilities on the campus
- Library interested in automation efforts

Interviewed: Lou Lucke, Computer Services Director  
Terrence Thompson, Director of Library

## MILES COMMUNITY COLLEGE

### NEEDS

- The College has a Title III grant from the U.S. Office of Education to investigate the use of interactive television to support instructional needs in Southeastern Montana
- Working with local school districts, with the University System, and with other agencies in developing programs through which, e.g., language, science and mathematics instructors can reach multiple classes simultaneously
- Interested in coordinating with our network planning

Interviewed: John Koch, Dean  
Syd Sonneborn, Director MCC-ITV







## APPENDIX C

### PRESENT WORTH ECONOMIC CALCULATIONS



## Present Worth Economic Calculations

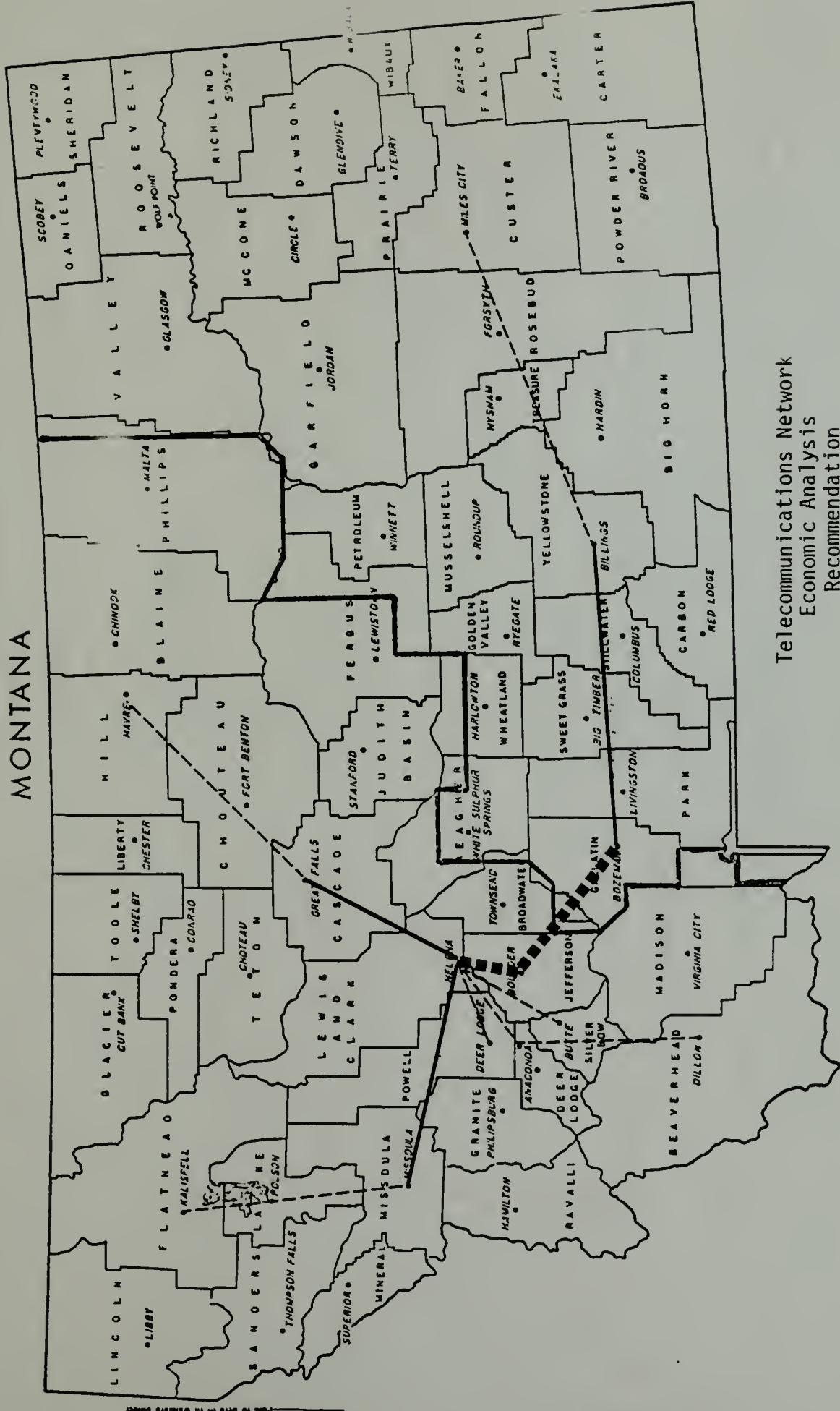
Economic Analysis Recommendations Facilities Map

Fundamental Plan Microwave Routing Map

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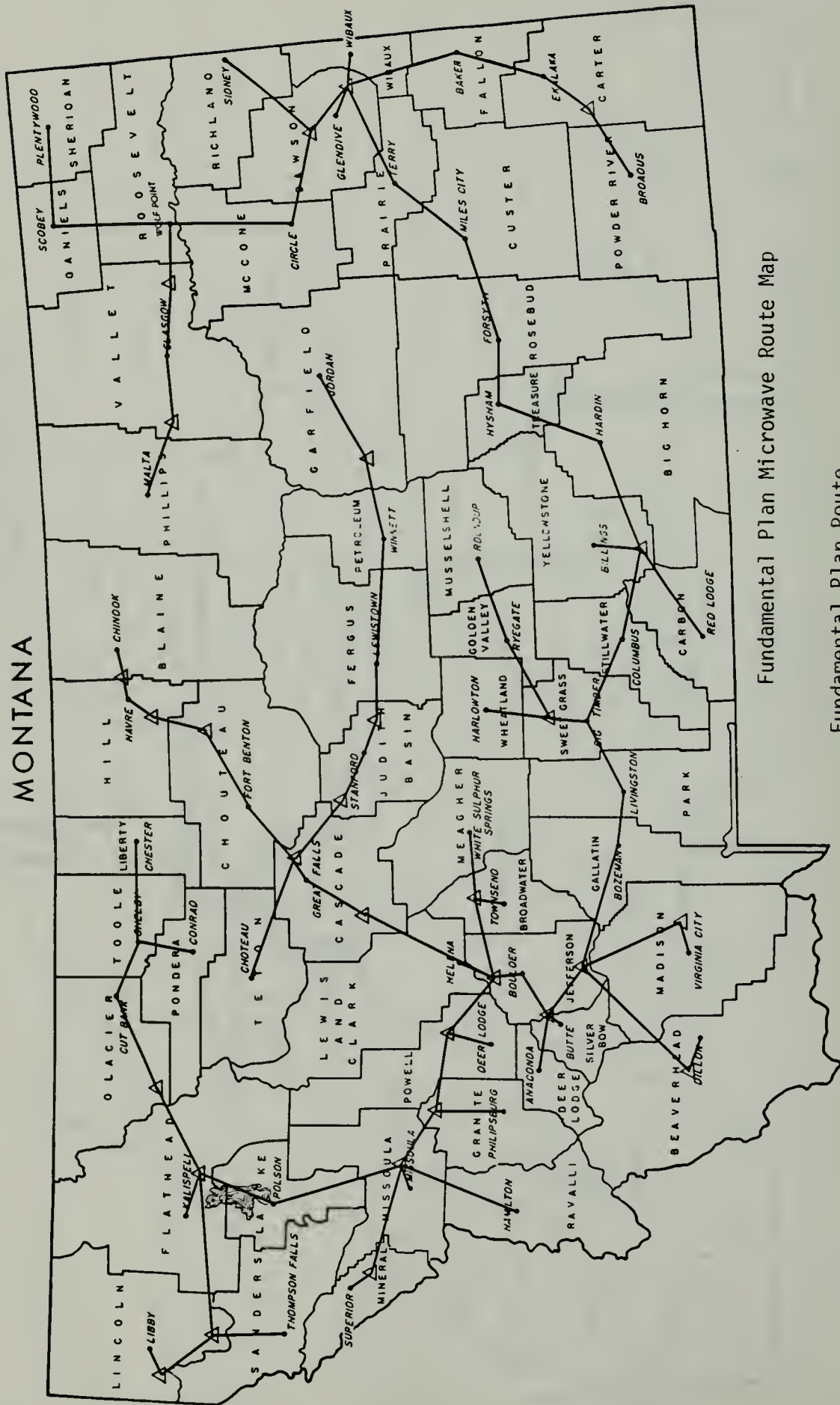


# MONTANA



Telecommunications Network  
Economic Analysis  
Recommendation

# MONTANA



Fundamental Plan Microwave Route Map

\_\_\_\_\_ Fundamental Plan Route

- County Seat
- Δ Repeater





**SECTION 1**

**HELENA-BOZEMAN**

**TELECOMMUNICATIONS ROUTE STUDY**



# HELENA-BOZEMAN ROUTE CIRCUIT REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Bozeman, 10FX, 20 tie-lines, 2 data	34	35	37	38	40	41
Helena-Billings, 22 voice, 3 data	27	28	29	30	32	33
Bozeman-Missoula, 6 voice	7	7	8	8	8	9
Billings-Missoula, 6 voice	7	7	8	8	8	9
Adjustment for rounding	<u>0</u>	<u>1</u>	<u>-1</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	75	78	81	84	88	92

5% added to 1986 requirement to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

The radios on this route are 192 channel capacity.

The Helena-Bozeman route is unique because Mountain Bell is legally prohibited from transporting circuits across the LATA line which has been imposed between Helena and Bozeman. Circuits are routed via Billings on AT&T facilities and backhauled to Bozeman on Mountain Bell facilities. This routing results in an unusually high circuit cost between Helena and Bozeman.

Five plans are compared in this analysis:

1. Conventional leased circuits routed via Billings
2. T1 Circuits. The transmission medium would be owned by one of the common carriers and the channel banks would be State owned.
3. Microwave radio and T1 channel banks. All facilities would be State owned. Boulder is a repeater point and could have access to the network at a small additional expense (not included in these costs).
4. Conventional circuits routed directly from city to city for all the circuits included in the cross section. This is the total cost of these circuits under the present routing. To compare these results with any of the other plans, a factor has been developed to add to each of the other plans to cover the extension of the circuits from Helena and Bozeman to their respective destinations.
5. Conventional circuits routed directly between Helena and Billings using intra-LATA charges. This plan is for illustration only. Federal regulation prevents Mountain Bell from offering this service.

The map illustrates the physical routing of the circuits.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

### Summary of Results

Present Worth of		
	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$5,415,637	Conventional circuits
Plan 2	2,040,657	T1 circuits
Plan 3	1,574,784	Microwave Radio
Plan 4	4,761,131	Conventional circuits routed directly
Plan 5	1,674,659	Conventional circuits without LATA restrictions
Comparison		
Factor	1,321,525	Add to plans 1,2,3, and 5 to compare with plan 4

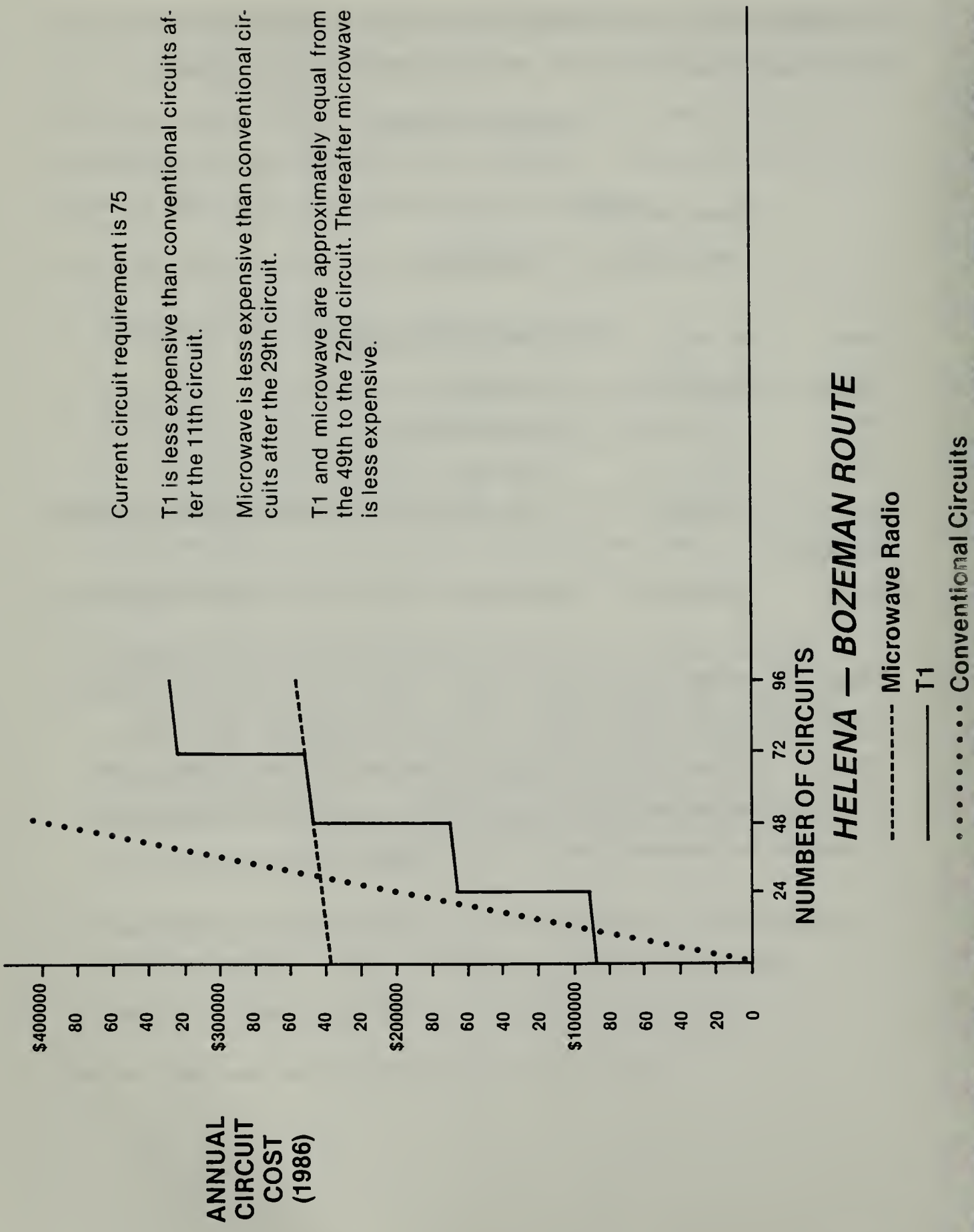
The results indicate that microwave radio is the most cost effective method of providing circuits in this route for the circuit quantities used in the analysis. T1 circuits are also economical and would be less expensive than microwave radio at lower circuit requirements. The cost relationships are illustrated in the annual costs for circuit graph.

Current circuit requirement is 75

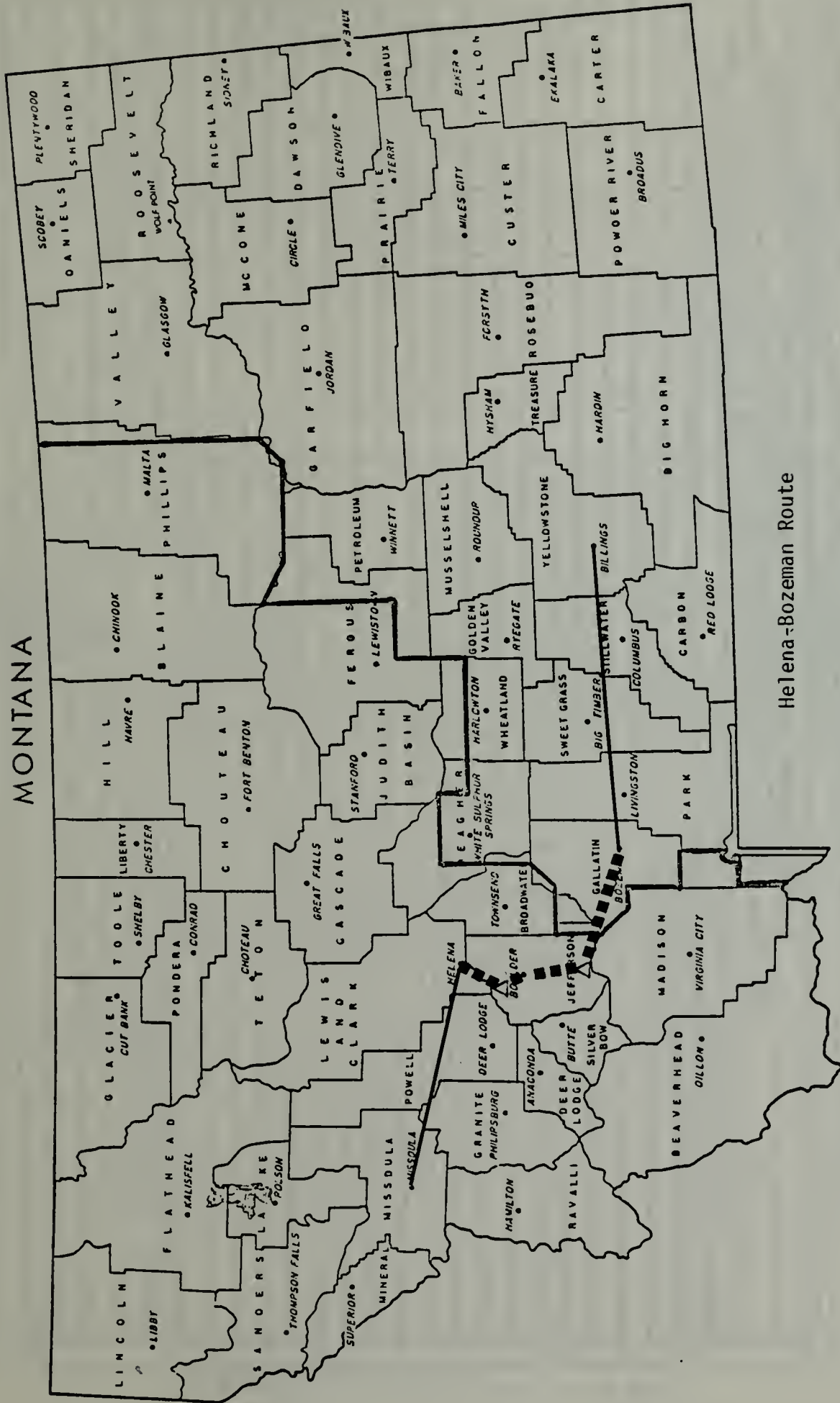
T1 is less expensive than conventional circuits after the 11th circuit.

Microwave is less expensive than conventional circuits after the 29th circuit.

T1 and microwave are approximately equal from the 49th to the 72nd circuit. Thereafter microwave is less expensive.



# MONTANA



Helena-Bozeman Route

• County Seat

△ Repeater

— Conventional Circuits (Plan 4)

--- Microwave Radio Route

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Bogenman Telecommunications Route  
Conventional Circuits

PLAN 1 OF 5 SHEET 1 OF 1  
PREP. BY DATE  
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	Monthly UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS			
			FIRST COST	DATE OF EXPEND.	PRESENT WORTH OF FIRST COST		ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS	
					AMOUNT	FACTOR	AMOUNT	PER CENT	AMOUNT	FACTOR
Helena - Bogenman Circuits	78	652	X 12.564	86			638,955		6,144	3,925,740
2% per year	3	746	"	88			28,118		4,408	123,944
Increase in circuit	3	855	"	90			32,327		2,974	95,843
requirement.	3	978	"	92			36,863		1,789	65,948
	4	1120	"	94			56,287		1,804	45,536
Circuit Cost Additions	78	93	X 12.564	88			91,139		4,408	401,741
7% per year	81	109	"	90			110,928		2,974	329,900
	84	123	"	92			129,811		1,789	232,232
Total	87	142	"	94			155,216		1,804	125,536
One-Time Installation	46	1208		86	1.0					5,346,453
Charge Increased at	3	1383		88						55,568
7% per year Existing	3	1583		90						3,429
circuits deducted from	3	1812		92						3,244
86 quantity	4	2076		94						3,069
Total										3,874
										5,415,637

REMARKS: Present worth of annuity factor for 12 monthly payments in advance of year end payment date = 1.047.  
12 x 1.047 = 12.564

NON-STANDARD ANNUAL COST PERCENTAGES				
(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

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# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Bozeman  
T1 Circuits

Life Communications Route

PLAN 2 OF 5 SHEET 1 OF 1  
PREP. BY M DATE 12/26/85  
STUDY PERIOD 1986 thru 1995

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS			PRESENT WORTH OF ANNUAL COSTS		
			FIRST COST	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD	FACTOR	AMOUNT
Channel Bank Comm. Equip	8	6000	48,000	86	1.0	48,000	22.7	10,896	10	6.144	66,945
Channel Units	156	260	40,560	86	1.0	40,560	22.7	9,207	10	6.144	56,568
Channel Units	6	260	1,560	88	.864	1,289	22.7	354	10-2	4.408	1,560
Channel Units	6	260	1,560	90	.680	1,065	22.7	354	10-4	2.974	1,053
Channel Units	6	260	1,560	92	.565	881	22.7	354	10-6	1.789	633
Channel Units	8	260	2,080	94	.465	970	22.7	472	10-8	.809	382
Total						92,765					
T1 Facility, Helena-Bozeman	4	Monthly Charge	Total Monthly Charge	Convert to Annual		Annual					
Local Connection	2	1000	2,000	X 12X	1.047	25,128			10	6.144	154,386
Local Connection	6	400	2,400	X 12X	1.047	30,154			10	6.144	185,266
Total			24,400			306,562					
1 Time Charge 1st T1	1	2400	2,400	86	1.0	2,400					2,400
1 Time Charge Additional T1s	3	1200	3,600	86	1.0	3,600					3,600
1 Time Charge 1st Local Con.	2	6000	12,000	86	1.0	12,000					12,000
1 Time Charge Additional L.C.	6	2000	12,000	86	1.0	12,000					12,000
Total						30,000					
Total											2,040,657

NON-STANDARD ANNUAL COST PERCENTAGES				
TYPE OF PLANT	(1)	(2)	(3)	(4)
C OF M	MW + Max			(5)
PROPERTY TAX	10.0			
INCOME TAX	0			
DEPRECIATION	6.7			
MAINTENANCE	6.0			
TOTAL	22.7			

REMARKS: Channel Banks owned by State.  
T1 Facilities Paid Monthly.

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# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helene - Bogemien Telecommunications Route  
Microwave Radio And T1 Channel Banks

PLAN 3 OF 5 SHEET 1 OF 2  
PREP. BY M DATE  
STUDY PERIOD 1986 - 1995

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS		
			FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS		
			AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	PERIOD FACTOR
Digital MW Radios, Termi.	2	54,900	109,800	86	1.0	109,800	22.7	10
Digital MW Radios, Rptr.	6	50,400	302,400			302,400	22.7	
Antenna System	8	9,000	72,000			72,000	22.7	
Battery & Power	5	5,600	28,000			28,000	22.7	
AC Generator	5	35,000	175,000			175,000	21.7	
Spaces	1 Lot	50,000	50,000			50,000	22.7	
Land and Site Work	2	30,000	60,000			60,000	18.0	
Building	2	25,000	50,000			50,000	21.7	
Site Work at Exist. Bldg	3	5,000	15,000			15,000	21.7	
Towers 150 ft	2	62,000	124,000			124,000	21.7	
Tower, Stub 30 ft	3	16,000	48,000			48,000	21.7	
Survey, FCC License, Freq. Coord	1 Lot	14,800	14,800			14,800	16.7	
System Design		75,000	75,000			75,000	16.7	
Channel Bank Comm. Equip.	8	6,000	48,000			48,000	22.7	
Channel units	156	220	40,560		Y	40,560	22.7	Y
Channel units	6	260	1,560	88	.8264	1,289	21.7	10-2
Channel units	6	260	1,560	90	.6830	1,065	22.7	10-4
Channel units	6	260	1,560	92	.5645	881	22.7	10-6
Channel units	8	260	2,080	94	.4665	970	22.7	10-8
Total			1,219,320			1,216,765		
						257,254		
						1,574,784		

REMARKS: Costs are installed costs.

Depreciation based on 15 year life, straight line  
Maintenance includes labor and material and State  
employee supervision (administrative). Survey and  
Design work annual charges have no maintenance  
content.

NON-STANDARD ANNUAL COST PERCENTAGES				
TYPE OF PLANT	(1)	(2)	(3)	(4)
MW & MUX		Towers	Buildings	Land
C OF M	10	10	10	10
PROPERTY TAX	0	0	0	0
INCOME TAX	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0
MAINTENANCE	6	5	5	8
TOTAL %	22.7	21.7	21.7	18
				21.7

# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Bozeman Telecommunications Route  
Microwave Radio and T1 Channel Banks

PLAN 3 OF 5 SHEET 2 OF 2  
PREP. BY h DATE  
STUDY PERIOD 1986 - 1995

Remaining Life Credit.

ITEM	First QUANTITY Cost	Credit Factor	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS			
			FIRST COST	DATE OF EXPEND.	PRESENT WORTH OF FIRST COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS		
							PER CENT	AMOUNT	PERIOD FACTOR
			AMOUNT		AMOUNT				AMOUNT
1 Digital MW Radio	1124500	.333	374,478	96	.3855	144,361			
2 System including Radios									
3 Antennas, Batteries,									
4 Generators, Spares,									
5 Buildings, Towers, Surveys,									
6 Design and Site Work and									
7 Initial Channels									
8									
9 Land, Repeater Sites	40,000	1.00	40,000	96	.3855	15,420			
10									
11 Channel Units	1560	.467	729	96	.3855	281			
12	1560	.60	936	96	.3855	361			
13	1560	.733	1143	96	.3855	441			
14	2080	.867	1903	96	.3855	734			
15									
16									
17									
18									
19									
20 Total						161,598			

REMARKS: Remaining life credit for 5 years of 15 year life is .333. Land is credited at 100% of First Cost. This information for reference only.					NON-STANDARD ANNUAL COST PERCENTAGES				
					(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT									
C OF M									
PROPERTY TAX									
INCOME TAX									
DEPRECIATION									
MAINTENANCE									
TOTAL %									

# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Bozeman  
Circuits Routed Directly - Common Carrier

PLAN 4 OF 5 SHEET 1 OF 3  
PREP. BY M DATE  
STUDY PERIOD 1984 thru 1995

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS					
			FIRST-COST <small>Convert to Annual Amount</small>	PRESENT WORTH OF FIRST-COST <small>DATE OF EXPEND.</small>	FACTOR	AMOUNT	ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS			
							PER CENT	AMOUNT	PERIOD	FACTOR	AMOUNT	
Helena - Bozeman	34	652	X 12 X 1.047	86					278,510	2	1.736	483,492
Helena - Billings	27	496	X 12 X 1.047	86					168,251	2	1.736	292,084
Bozeman - Missoula	7	752	X 12 X 1.047	86					66,134	2	1.736	114,809
Billings - Missoula	7	546	X 12 X 1.047	86					52,415	2	1.736	90,993
Total												
Helena - Bozeman	35	746	X 12 X 1.047	88					328,046	4-2	1.434	470,418
Helena - Billings	28	568	X 12 X 1.047	88					199,818	4-2	1.434	286,539
Bozeman - Missoula	7	861	X 12 X 1.047	88					75,723	4-2	1.434	108,587
Billings - Missoula	7	682	X 12 X 1.047	88					59,981	4-2	1.434	86,012
Total												
Helena - Bozeman	37	855	X 12 X 1.047	90					397,462	6-4	1.185	470,993
Helena - Billings	29	650	X 12 X 1.047	90					236,831	6-4	1.185	280,645
Bozeman - Missoula	8	986	X 12 X 1.047	90					99,105	6-4	1.185	117,439
Billings - Missoula	8	781	X 12 X 1.047	90					78,500	6-4	1.185	93,022
Total												
Helena - Bozeman	38	978	X 12 X 1.047	92					466,927	8-6	.980	457,590
Helena - Billings	30	744	X 12 X 1.047	92					280,428	8-6	.980	274,820
Bozeman - Missoula	8	1129	X 12 X 1.047	92					113,478	8-6	.980	111,208
Billings - Missoula	8	894	X 12 X 1.047	92					89,858	8-6	.980	88,061
Sub-Total												3,826,712

REMARKS: See page 1 of Plan 1 for Rate Increase Percentages.

These circuits represent the present facility routing of the circuits.

NON-STANDARD ANNUAL COST PERCENTAGES				
(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

**DESCRIPTION:**[illegible]

REMARKS: Installation Charge for additional study circuits during year 1, 1986 was not included because it would not be incurred if the method of operation does not change. The additional circuit costs are included to represent traffic costs overflowed to other circuits such as WATS.

NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

# ECONOMIC SELECTION STUDY

## DESCRIPTION:

Helena - Bozeman Telecommunications Route  
Conventional Circuits - No LATA (See note)

PLAN 5 OF 5 SHEET 1 OF 1  
PREP. BY A DATE  
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	-CAPITAL REQUIREMENTS-				REVENUE REQUIREMENTS			
			FIRST COST Convert to Amount	DATE OF EXPEND.	FACTOR	AMOUNT	ANNUAL COST			
							PER CENT	AMOUNT	PERIOD	PRESENT WORTH OF ANNUAL COSTS
Approximate costs	78	200	X 12.564	86			195,992	10	6.144	1,204,175
if LATA did not re-	3	229		88			8,631	10-2	4.408	38,045
quire special routing.	3	262		90			9,875	10-4	2.974	29,328
81 miles at common	3	300		92			11,308	10-6	1.789	20,230
carrier mileage charge,	4	344	X	94			17,288	10-8	.809	13,986
\$1.6/mile and termination										
charge, \$70/circuit.										
Price Increases at	78	29	X 12.564	88			28,420	10-2	4.408	125,275
7070/yr.	81	33		90			33,584	10-4	2.974	99,879
	84	38		92			40,104	10-6	1.789	71,746
	87	44	X	94			48,095	10-8	.809	38,909
Total										1,641,613
One time installation										26,542
Charge. Increased at										1,639
7070/yr. Existing										1,549
circuits deducted										1,467
from '86 quantity.										1,849
Total										1,674,659

REMARKS: This plan is for illustration only. Government regulations prevent circuits from being routed across LATA boundaries by Mountain Bell. These costs are based on intra-LATA tariffs. They would be actual costs if the LATA did not exist.

NON-STANDARD ANNUAL COST PERCENTAGES				
(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

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# ECONOMIC SELECTION STUDY

## DESCRIPTION:

Helena - Bozeman Telecommunication Route  
Factors To Add To Plans For Comparison With Current Cmts.

PLAN 2-3-5 OF SHEET 1 OF 1  
PREP. BY DATE  
STUDY PERIOD 8C thru 95

ITEM	QUANTITY	UNIT COST	-CAPITAL REQUIREMENTS-				REVENUE REQUIREMENTS			
			FIRST COST Convert to Annual	DATE OF EXPEND.	FACTOR	AMOUNT	ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS	
							PER CENT	AMOUNT	PERIOD	AMOUNT
Helena - Missoula	14	224	X 12.564	86				39,400	2	1.736 68,398
Bozeman - Billings	34	267		86				114,052	2	1.736 197,994
Helena - Missoula	14	256		88				45,029	4-2	1.434 64,572
Bozeman - Billings	35	306		88				134,560	4-2	1.434 192,959
Helena - Missoula	16	294		90				59,101	6-4	1.185 70,035
Bozeman - Billings	37	350		90				162,704	6-4	1.185 192,804
Helena - Missoula	16	336		92				67,544	8-6	.980 66,193
Bozeman - Billings	38	401		92				191,450	8-6	.980 187,621
Helena - Missoula	16	385		94				77,394	10-8	.809 62,612
Bozeman - Billings	40	459		94				230,675	10-8	.809 186,616
One-Time Installation Charge	48	577								
	1	661								27,696
	4	756								546
	1	866								2,065
	2	991								489
										925
Total							(1)	(2)	(3)	(4) 1,321,525

## REMARKS:

These factors are the costs of extending the "through" circuits beyond Helena and Bozeman to their terminations.

TYPE OF PLANT	(1)	(2)	(3)	(4)	(5)
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL					

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**SECTION 2**

**HELENA-MISSOULA**

**TELECOMMUNICATIONS ROUTE STUDY**



Three plans are compared in the analysis of the Helena-Missoula route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.  
The terminal at Helena and the first repeater have reduced costs because it is assumed that they have been installed for the Helena-Bozeman route.
3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

#### Summary of Results

##### Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$1,136,442	Conventional circuits
Plan 2	1,551,223	Microwave Radio
Plan 3	665,580	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant. The conventional circuit line on the graph would swing further toward the vertical on the graph each year.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

A map of Montana showing county boundaries and names. A thick black line traces the Helena-Missoula Route, starting from Helena in the south and ending at Missoula in the north. The route passes through or near several counties including Lincoln, Sanders, Lake, Mineral, Missoula, Powell, Glacier, Toole, Liberty, Chouteau, Teton, Cascade, Lewis and Clark, Blaine, Phillips, Chino, and Missoula. Major cities like Helena, Missoula, and Butte are marked along the route.

## ■ ■ ■ ■ ■ Microwave Radio Route

## Δ Repeater

HELENA-MISSOULA ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Missoula, 27 voice , 1 data	29	31	32	33	34	36
Helena-Kalispell, 1 data	1	1	1	1	1	1
Missoula-Billings, 6 voice	6	6	7	7	7	7
Missoula-Bozeman, 6 voice	6	6	7	7	7	7
Adjustment for rounding	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>
TOTAL	43	45	47	48	50	52

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per annum.

48 circuits are installed initially. Additional common equipment and 4 channels are installed in 1992 for growth.

Missoula-Helena has 2 terminals and 4 repeater sites. One repeater site would be in place if the Helena-Bozeman route was installed. The Helena terminal and the repeater site costs reflect the additional equipment added for this route.

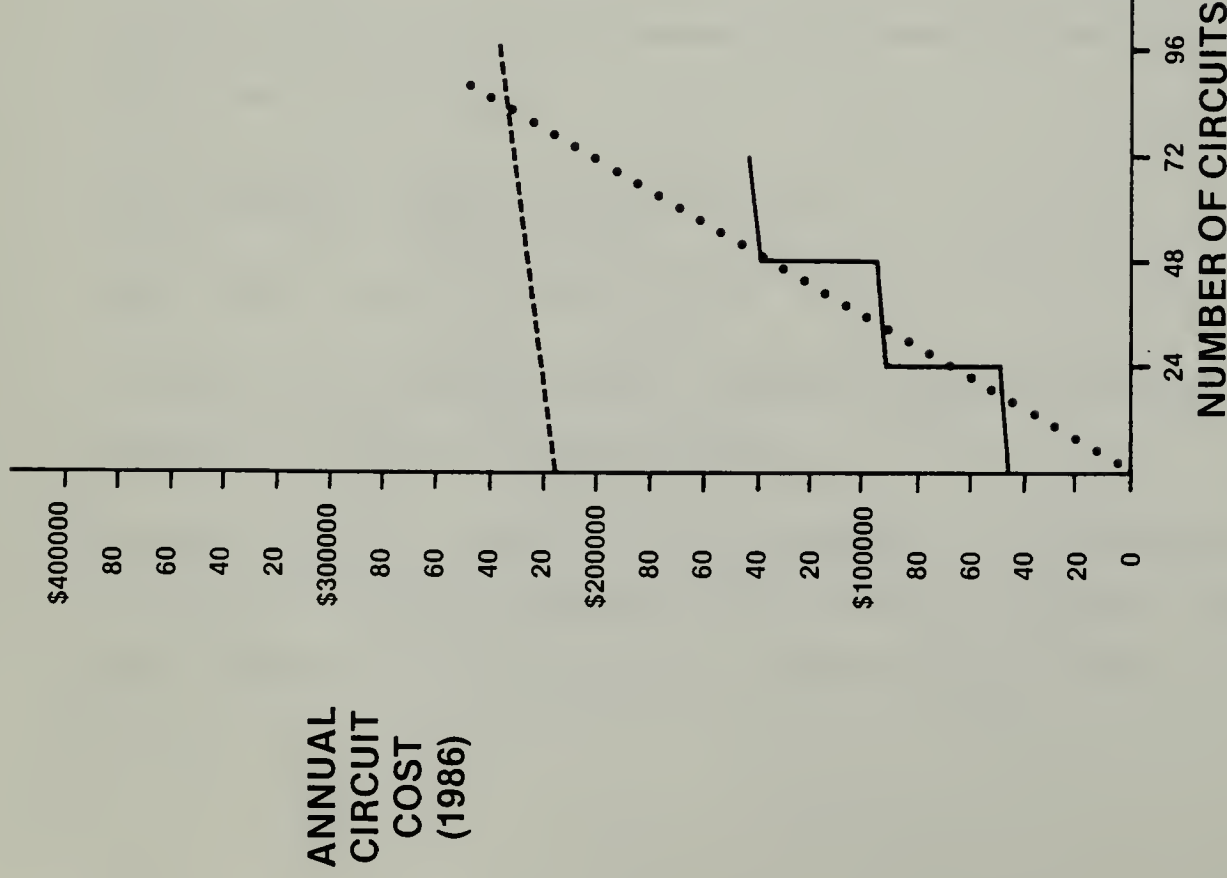
The radios on this route are 96 channel capacity.

Current circuit requirement is 43

T1 is less expensive than conventional circuits after the 16th circuit and through the 24th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

T1 is less expensive than microwave at all circuit requirements up to the capacity of the radio.

Microwave is less expensive than conventional circuits after the 83rd circuit.



**DESCRIPTION:**

Helena - Missoula Telecommunications Route  
TL Circuits

PLAN 3 OF 3 SHEET 1 OF 1  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

[illegible]

## REMARKS:

TI costs are from Mt. Bell based on 5 year contract

	NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

REMARKS:

TI costs due from Mt. Bell based on 5 year contract

**DESCRIPTION:**

Telecommunications Route

PLAN 1 OF 3 SHEET 1 OF 1  
PREP. BY hy DATE \_\_\_\_\_  
STUDY PERIOD 86-11-95

REMARKS:  
Deducted existing ckts from one time charge quantity

	NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

**EXHIBIT**

Deducted existing ckts from one time charge quantity

**DESCRIPTION:**

PLAN 2 OF 3 SHEET 1 OF 3  
PREP. BY my DATE \_\_\_\_\_  
STUDY PERIOD 86 Nov. 95

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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## REMARKS:

# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helene - Missoula Telecommunications Route  
Microwave Radio Repeater Sites Unit Costs

PLAN 2 OF 3 SHEET 2 OF 3  
PREP. BY m DATE  
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS			
				FIRST COST	PRESENT WORTH OF FIRST COST	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS
				AMOUNT	AMOUNT			AMOUNT		AMOUNT	AMOUNT
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11	Remote Repeaters										
12	Spare, Each Site	1 Lot	10,000	10,000							
13	Digital Microwave Radio	2	30,400	100,800					22.7	2,270	13,947
14	Antenna System	2	9,000	18,000					22.7	22,882	140,587
15	Battery and Power	1	5,600						22.7	4,086	25,104
16	AC Generator	1	35,000	35,000					22.7	1,271	7,809
17	Tower, 150 Ft.	1	62,000	62,000					21.7	7,595	46,664
18	Land And Site Work	1	30,000	30,000					21.7	13,454	82,661
19	Building	1	25,000	25,000					18.0	5,400	33,178
20	Total			286,400					21.7	54,255	353,331
										62,383	383,281

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	24.7

ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Missoula Telecommunications Route  
Microwave Radio Terminal Site Unit Costs  
PLAN 2 OF 3 SHEET 3 OF 3  
PREP. BY M DATE  
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS		
			FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS		
			AMOUNT	DATE OF EXPEND.	AMOUNT	PER CENT	AMOUNT	PERIOD FACTOR
Complete Term. Site								
Digital Microwave Radio	1	54,900	54,900	86	1.0	22.7	12,462	10 6.144
Antenna System	1	9,000	9,000			22.7	2,043	
Battery and Power	1	5,600	5,600			22.7	1,271	
AC Generator	1	35,000	35,000			21.7	7,595	
Tower, Stab, 30 Ft.	1	16,000	16,000			21.7	3,472	
Site Work, Existing Bldg.	1 Lot	5,000	5,000			21.7	1,085	
Total			125,500					
Spares, Each Site	1 Lot	10,000	10,000			22.7	2,270	
Total			135,500				30,198	
Partial Term. Site								
Digital Microwave Radio	1	54,900		86	1.0	22.7	12,462	10 6.144
Antenna System	1	9,000		"	"	22.7	2,043	
Total		63,900					14,505	
Partial Repeater Site								
Digital Microwave Radio	2	54,900	109,800	86	1.0	22.7		
Antenna System	2	9,000	18,000	"	"	22.7		
Total			127,800				29,011	10 6.144

REMARKS:	NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)	(5)
	TYPE OF PLANT				
	C OF M				
	PROPERTY TAX				
	INCOME TAX				
	DEPRECIATION				
	MAINTENANCE				
	TOTAL %				

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**SECTION 3**

**HELENA-GREAT FALLS**

**TELECOMMUNICATIONS ROUTE STUDY**



Three plans are compared in the analysis of the Helena-Great Falls route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.  
The terminal at Helena and the first repeater have reduced costs  
because it is assumed that they have been installed for other routes.
3. T1 circuits. The transmission medium would be owned by a common  
carrier and the channel banks would be State owned.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities  
and costs of all facilities, the annual charges and the calculations.

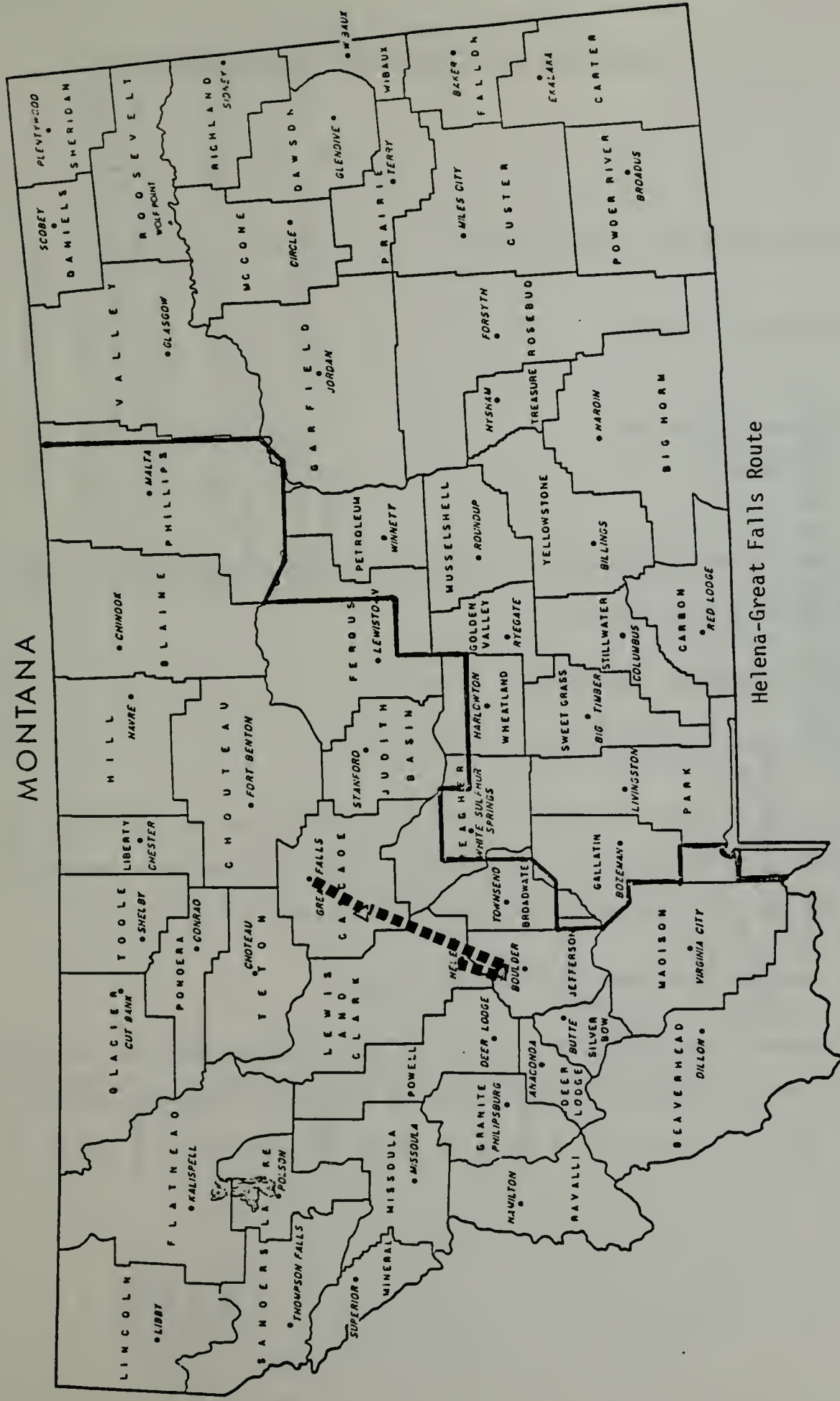
## Summary of Results

### Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 681,203	Conventional circuits
Plan 2	820,450	Microwave Radio
Plan 3	482,696	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant.

# MONTANA



Helena-Great Falls Route

■ Microwave Radio Route

• County Seat

△ Repeater

# HELENA-GREAT FALLS ROUTE CIRCUIT REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Great Falls, 20 voice, 3 data	24	25	26	27	28	29
Helena-Havre, 8 voice	8	9	9	9	10	10
Adjustment for rounding	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>1</u>
TOTAL	33	34	35	37	38	40

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

The growth is less than would require a third channel bank so 36 circuits are used to represent the total. Small additions or reductions would not change the results within the acceptable level of accuracy.

The radios on this route are 96 channel capacity.

One repeater site would be in place if the Helena-Bozeman route was installed. Helena terminal and the repeater site costs reflect the equipment added for this route.

Current circuit requirement is 33

T1 is less expensive than conventional circuits after the 14th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

Microwave is less expensive than conventional circuits after the 56th circuit.

Microwave radio is less expensive than T1 after the 72nd circuit.

ANNUAL  
CIRCUIT  
COST  
(1986)

\$400000

80

60

40

20

\$300000

80

60

40

\$200000

80

60

40

\$100000

80

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40

20

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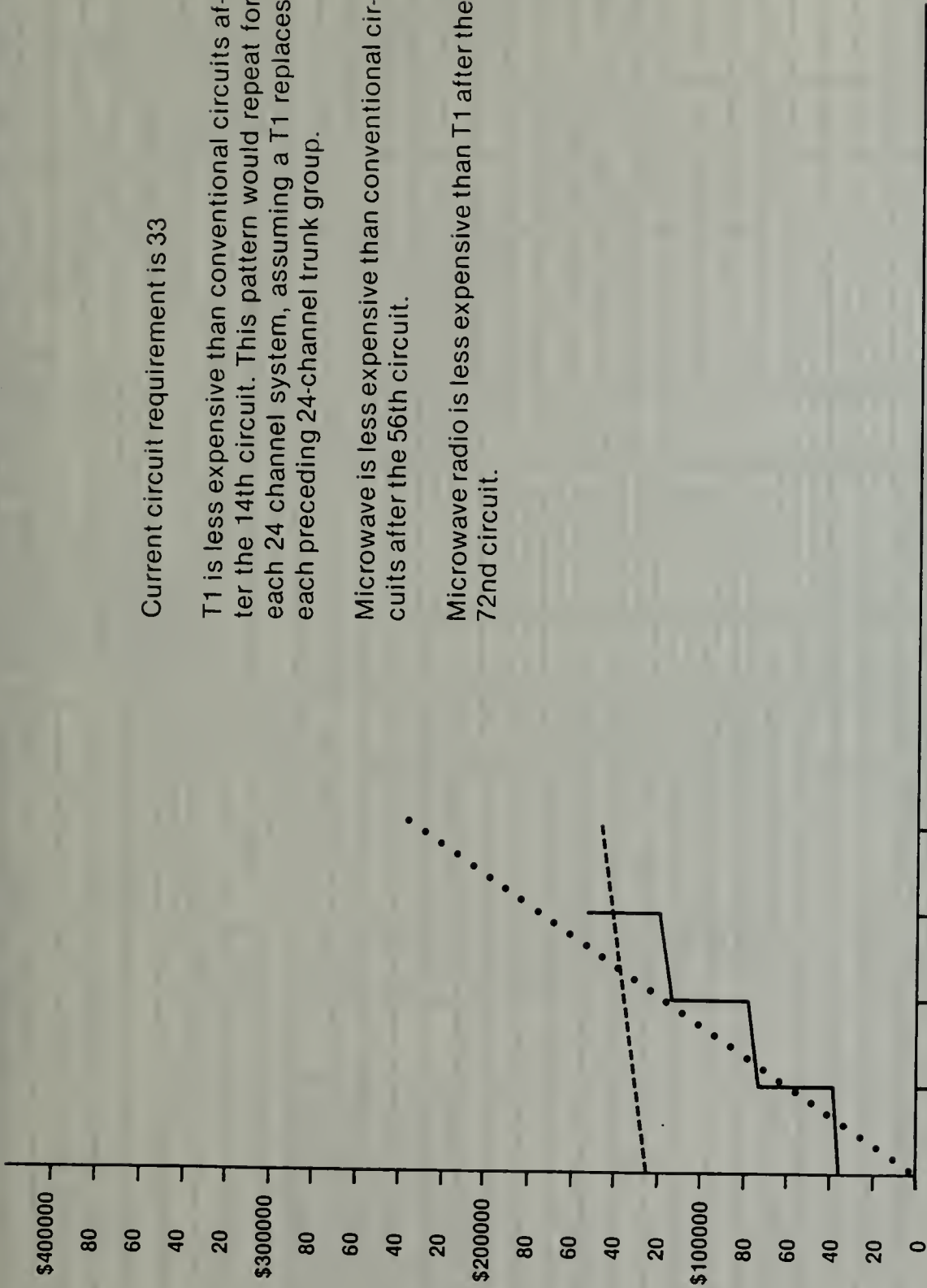
24 48 72 96  
NUMBER OF CIRCUITS

## HELENA — GREAT FALLS ROUTE

----- Microwave Radio

—— T1

..... Conventional Circuits



# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Great Falls Telecommunications Route  
Conventional Circuits

PLAN 1 OF 3 SHEET 1 OF 1  
PREP. BY hm DATE \_\_\_\_\_  
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS					
			FIRST COST	DATE OF EXPEND.	FACTOR	PRESENT WORTH OF FIRST COST	ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS			
							Convert To Annual Amount	Amount	PER CENT	AMOUNT	PERIOD	FACTOR
Helena - Great Falls Ckts	36	185	X 12.564	86		83,676				10	6.144	514,105
ckt Cost Additions 7% / yr	36	12.95	X 12.564	87		5857				10-1	5.232	30,644
		13.86		88		6269				10-2	4.408	27,634
		14.81		89		6703				10-3	3.657	24,513
		15.87		90		7178				10-4	2.974	21,347
		16.97		91		7676				10-5	2.353	18,062
		18.17		92		8218				10-6	1.789	14,702
		19.43		93		8788				10-7	1.276	11,213
		20.79		94		9403				10-8	.809	7,607
	Y	22.25	Y	95		10064				10-9	.385	3,875
One time installation chg	13	577		86	1	7501						7,501
Total												681,203

REMARKS:

Deducted existing circuits from one time charge quantity.

NON-STANDARD ANNUAL COST PERCENTAGES				
(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

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# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Great Falls Telecommunications Route  
Microwave Radio And T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3  
PREP. BY A DATE  
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS		
			FIRST COST	PRESENT WORTH OF FIRST COST		ANNUAL COST	PRESENT WORTH OF ANNUAL COSTS	
			AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT
Microwave Radio Equip								
Terminal Site Complete	1	135,500	135,500	86	1.0	30,198	8.3	185,537
Remote Repeater Comp.	1	286,400	286,400	86	1.0	62,383	8.2	383,281
Terminal Site Partial	1	63,900	63,900	86	1.0	14,505	22.7	89,119
Remote Repeater Partial	1	127,800	127,800	86	1.0	29,011	22.7	178,244
Deduct for 96 Ch Radios	6	9,000	(54,000)	86	1.0	(12,258)	22.7	(75,313)
						123,839		760,868
Channel Bank Comm. Equip	4	6000	24,000	86		5,448	22.7	33,473
Channel Units	72	260	18,720	86		4,249	22.7	26,109
Total								820,450

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)
TYPE OF PLANT				(5)
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

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# ECONOMIC SELECTION STUDY

## DESCRIPTION:

Helene - Great Falls Telecommunications Route  
Microwave Radio Repeater Sites

PLAN 2 OF 3 SHEET 2 OF 3  
PREP. BY my DATE \_\_\_\_\_  
STUDY PERIOD 86 thru 95

[illegible][illegible]

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	M W + MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	21.7

# MINIMUM SELECTION STUDY

## Helena - Great Falls Telecommunications Route Microwave Radio Terminal Site

[illegible]

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

# ECONOMIC SELECTION STUDY

**DESCRIPTION:**

Helenz - Great Falls Telecommunications Route  
T1 Circuits

PLAN 3 OF 3 SHEET 1 OF 1  
PREP. BY Am DATE \_\_\_\_\_  
STUDY PERIOD 86 Nov 95.

[illegible]

REMARKS: \_\_\_\_\_  
 TI Costs are from common carrier based  
 on 5 year contract.

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20





**SECTION 4**

**BILLINGS-BOZEMAN**

**TELECOMMUNICATIONS ROUTE STUDY**



Three plans are compared in the analysis of the Bozeman-Billings route as follows:

1. Conventional circuits as used at present

2. Microwave radio with T1 channel banks, all facilities are State owned.

The terminal at Bozeman has been reduced in cost because it is assumed that the support work had been accomplished for the Helena-Bozeman route. Livingston, Big Timber, and Columbus are repeater points and could have access to the network at a small additional expense not included in these costs. If considered desirable, this drop and insert capability should be provided when the system is first constructed.

3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

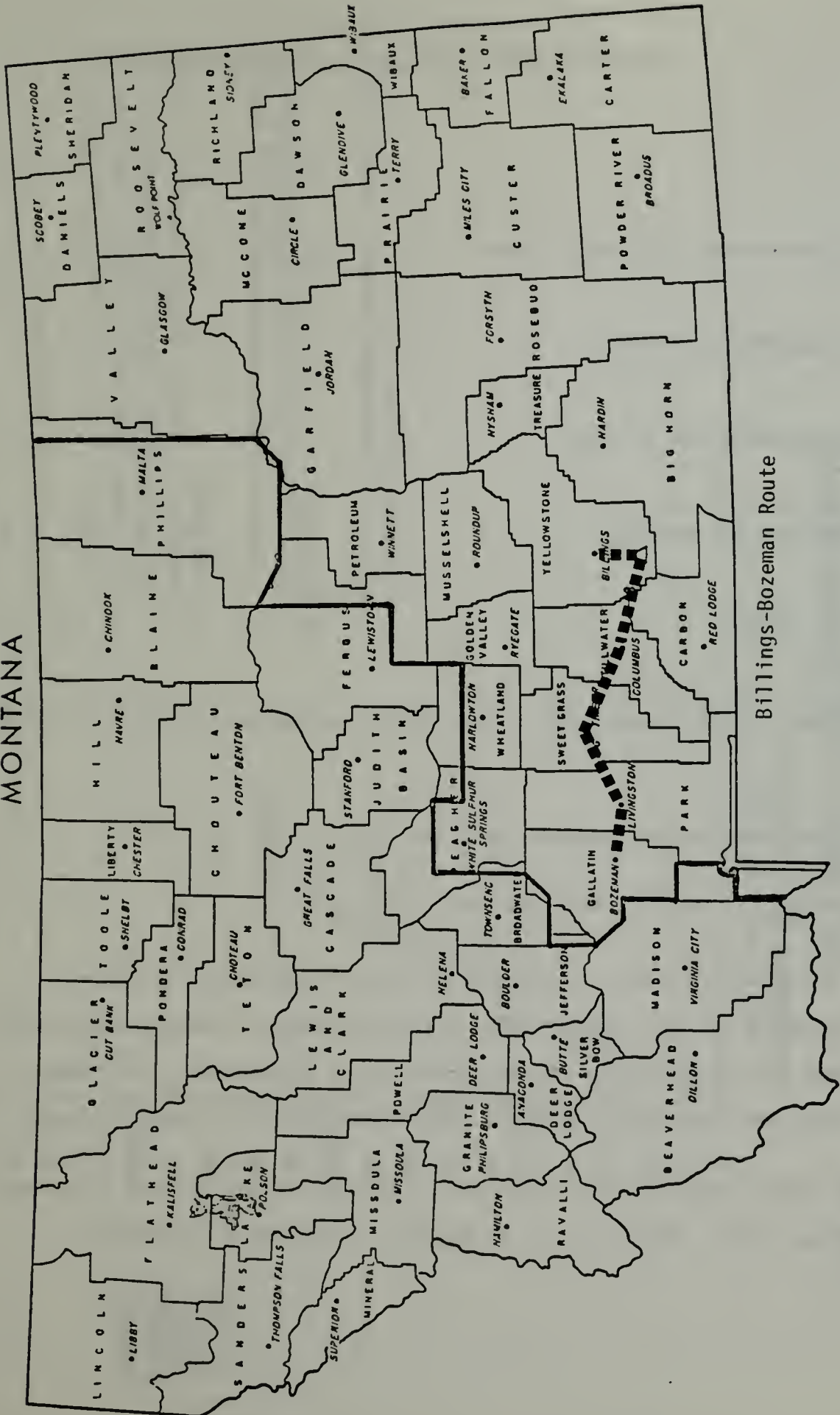
## Summary of Results

### Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$1,155,191	Conventional circuits
Plan 2	1,382,675	Microwave Radio
Plan 3	716,157	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant.

# MONTANA



Billings-Bozeman Route

■■■■■■■■■■ Microwave Radio Route

• County Seat

△ Repeater

BILLINGS-BOZEMAN ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Billings-Helena, 22 voice, 3 data	27	28	28	30	30	31
Billings-Bozeman, 6 voice	6	6	7	7	7	7
Billings-Missoula, 6 voice	6	6	7	7	7	7
Adjustment for rounding	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>2</u>
TOTAL	39	40	42	44	46	47

5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

As the growth is small, 42 circuits are used to represent the nominal requirement for the study period. Small additions or reductions would not change the results within the acceptable level of accuracy. The growth through the study period does not require additional T1 common equipment.

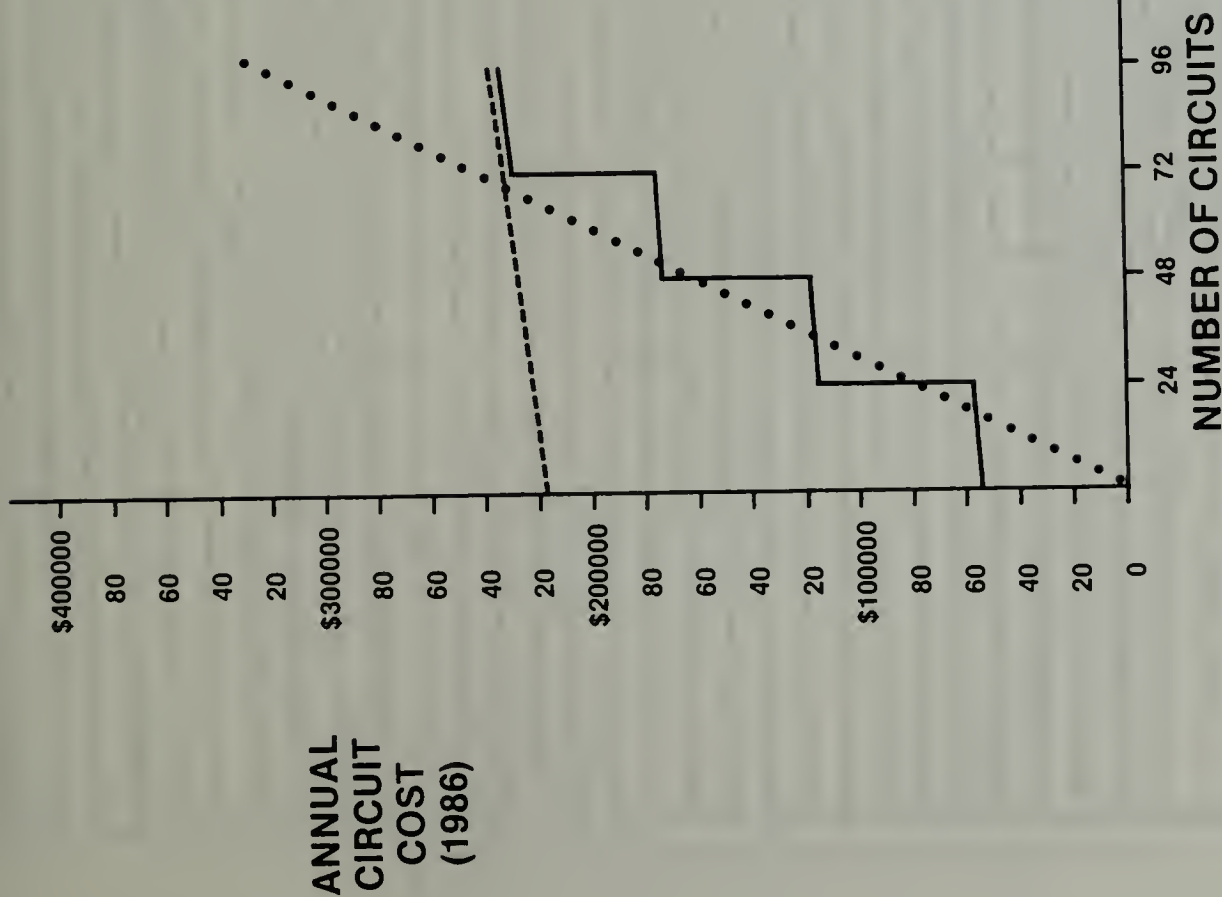
The Bozeman terminal site is assumed to have been installed for the Helena-Bozeman route. The costs for the equipment was reduced accordingly.

Current circuit requirement is 39

T1 is less expensive than conventional circuits after the 16th circuit and through the 24th. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

T1 is less expensive than microwave until the 73rd circuit. They are approximately equal through the 96th circuit.

Microwave is less expensive than conventional circuits after the 68th circuit.



### DESCRIPTION:

# Billings - Bozeman Telecommunications Route Conventional Circuits

PLAN 1 OF 3 SHEET 1 OF 1  
PREP. BY AM DATE \_\_\_\_\_  
STUDY PERIOD 86 thru 95

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# STREET

[illegible]

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

# ECONOMIC SELECTION STUDY

DESCRIPTION:

Billings - Bozeman Telecommunications Route  
Microwave Radio And T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3  
PREP. BY h DATE  
STUDY PERIOD 86 thru 95

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS			REVENUE REQUIREMENTS			
			FIRST COST	PRESENT WORTH OF FIRST COST	DATE OF EXPEND.	FACTOR	ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS
							AMOUNT	PER CENT	
Channel Bank Comm. Equip	4	6000	24,000		86	1.0			
Channel Units	84	260	21,840		86	1.0			
Total			45,840					22.7	63,932
Microwave Radio Equip									
Terminal Site Complete	1	135,500	135,500		86	1.0			
Terminal Site Partial	1	63,900	63,900		86	1.0	30,198	13.3	185,537
County Seat Rptr.	3	110,400	571,200		86	1.0	14,505	13.3	89,119
Remote Repeater	1	277,400	286,400		86	1.0	127,983	13.2	786,328
Total			1,102,840				62,383	13.2	383,281
Deduct for 96ch radio	10	9000	(90,000)		86	1.0	(20,430)	22.7	(125,522)
Total			1,012,840						1,383,675

REMARKS:


NON-STANDARD ANNUAL COST PERCENTAGES				
TYPE OF PLANT	(1)	(2)	(3)	(4)
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PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

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# ECONOMIC SELECTION STUDY

[illegible]

Telecommunications Route

PLAN 2 OF 3 SHEET 3 OF 3  
PREP. BY LM DATE 8/14/02

SHEET 3 OF 3

1

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS							
			FIRST COST		PRESENT WORTH OF FIRST COST		ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS					
			AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD	FACTOR	AMOUNT			
Complete														
Digital Microwave Radio	1	54,900	54,900	86	1.0		22.7	12,462	10	6.144	76,567			
Antenna System	1	9,000	9,000				22.7	2,043			12,552			
Battery and Power	1	5,600	5,600				22.7	1,271			7,809			
AC Generator	1	35,000	35,000				21.7	7,595			46,664			
Tower Stab, 30 Ft.	1	16,000	16,000				21.7	3,472			21,332			
Site Work, Existing Bldg.	1 Lot	5,000	5,000				21.7	1,085			6,666			
Total			125,500											
Species, Each Site	1 Lot	10,000	10,000				22.7	2,270			13,947			
Total			135,500					30,198			185,537			
Partial														
Digital Microwave Radio	1	54,900		86	1.0		22.7	12,462	10	6.144	76,567			
Antenna System	1	9,000		"	"		22.7	2,043			12,552			
Total		63,900						14,505			89,119			

**REMARKS:**

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
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PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

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# ECONOMIC SELECTION STUDY

DESCRIPTION:

Billings - Bozeman Telecommunications Route  
T1 Circuits

PLAN 3 OF 3 SHEET 1 OF 1  
PREP. BY DATE

STUDY PERIOD

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS			
			FIRST COST	DATE OF EXPEND.	PRESENT WORTH OF FIRST COST	PER CENT	ANNUAL COST	PERIOD FACTOR	PRESENT WORTH OF ANNUAL COSTS	AMOUNT
			AMOUNT							
Channel Bank & Ch. Equip	4/84	6000/360	45,840	86	1.0	22.7	10,406	10	6,144	63,932
T1 Facility	2	Monthly Charge Factor To Annual Contract To Ann	4200 x 12.564				105,538	10	6,144	648,425
1 time Charge 1st Ckt	1	2100		86	1.0					2,100
" " Subsequent	1	1700		86	1.0					1,700
Total										716,157

REMARKS:

T1 Costs are for 5 year contract

NON-STANDARD ANNUAL COST PERCENTAGES				
(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT				
C OF M				
PROPERTY TAX				
INCOME TAX				
DEPRECIATION				
MAINTENANCE				
TOTAL %				

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**SECTION 5**

**HELENA-BUTTE**

**TELECOMMUNICATIONS ROUTE STUDY**



Three plans are compared in the analysis of the Helena-Butte route as follows:

1. Conventional circuits as used at present
2. Microwave radio with T1 channel banks, all facilities are State owned.  
The microwave radio route is assumed to be in place from Helena to the third repeater for the Helena-Bozeman route. A cost is added for the drop and insert capability at the third repeater and a new radio and antenna system is installed there for the new route extending west to Butte. The initial Helena-Bozeman radios have ample capacity to add these requirements. A complete repeater site is required before Butte and a complete terminal site is required at Butte. Channel banks are installed at Helena and at Butte.
3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs for all facilities, the annual charges and the calculations.

## Summary of Results

### Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 315,736	Conventional circuits
Plan 2	652,9475	Microwave Radio
Plan 3	187,526	T1 Circuits

The results indicate that T1 is clearly more economical for circuit requirements greater than 16 on the route at the present rates. T1 is significantly more cost effective than conventional circuits over the life of the study, but savings are not projected in the initial year. As these results are borderline but not conclusive at this time, it is recommended that the route be included in the request for proposal for T1 circuits. The results of the proposal could determine the decision to continue with conventional circuits or change to T1. Any increase in conventional circuit costs would tend to prove in T1 as would a requirement for 56 Kbps data and an increase in the circuit requirements.

MONTANA

Helena-Butte Route

## Helena-Butte Route

## Microwave Radio Route

County Seat

## Repeater

•

△

No. 1051 — Century machine Map (\$50 to a pad)  
9-1-10 Dept. 1000, Co. 10000 to 101

—Field to be used in the standard layout

# HELENA-BUTTE ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Butte, 15 voice	19	20	21	21	22	23

5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

As the circuit requirement is small, 21 circuits are used to represent the nominal requirement for the study period. Small additions or reductions would not change the results within the acceptable level of accuracy. The growth through the study period does not require additional T1 common equipment.

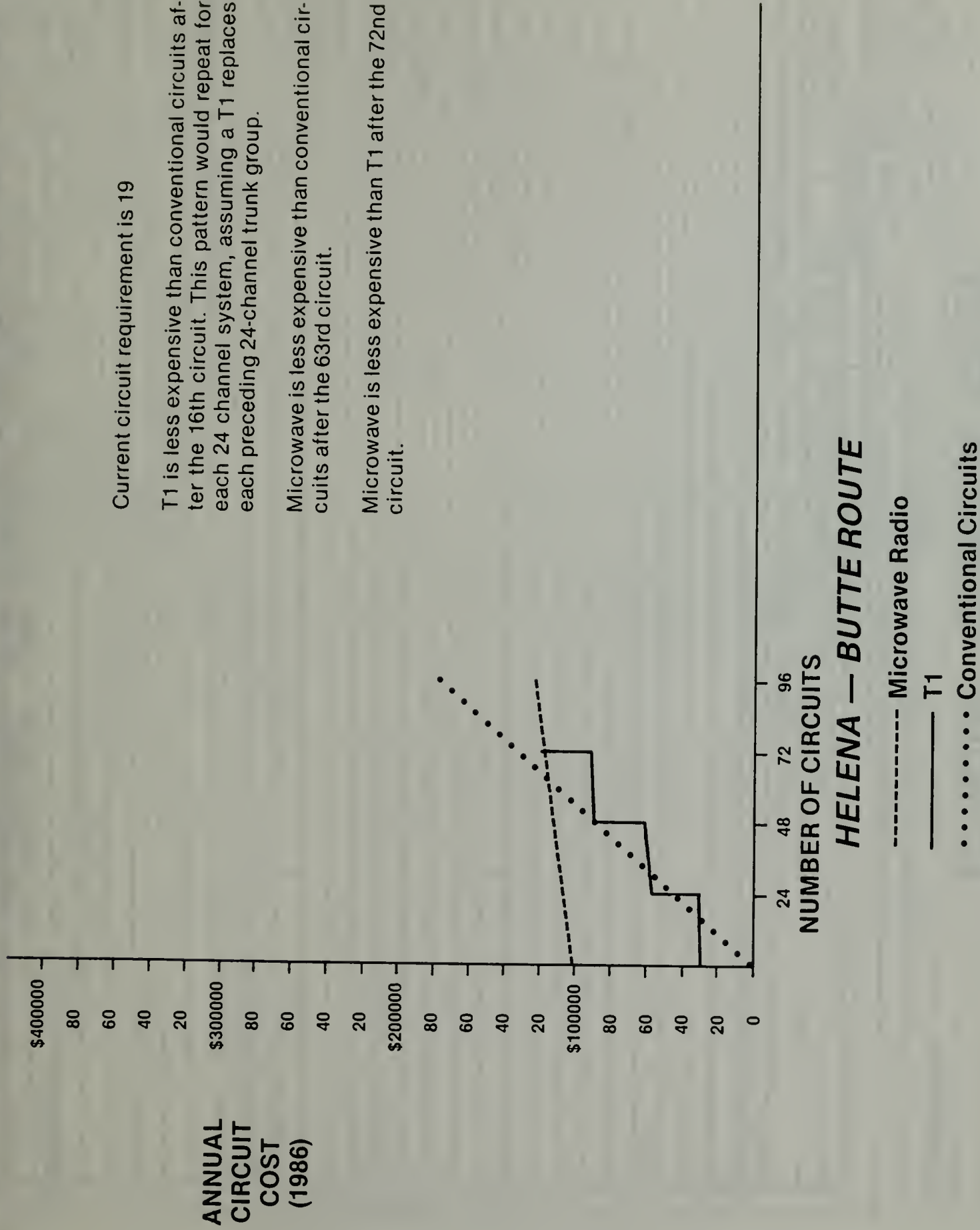
All but one repeater and the Butte terminal are assumed to have been installed for the Helena-Bozeman route. The costs for the equipment was reduced accordingly. A cost was added to one of the repeaters for the drop and insert capability required to add the leg to Butte from the repeater. See map.

Current circuit requirement is 19

T1 is less expensive than conventional circuits after the 16th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

Microwave is less expensive than conventional circuits after the 63rd circuit.

Microwave is less expensive than T1 after the 72nd circuit.



**DESCRIPTION:**

PLAN ✓ OF 3  
PREP. BY \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

PLAN 1 OF 3 SHEET 1 OF 1  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD 1986-95

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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## Reviews:

[illegible]

# ECONOMIC SELECTION STUDY

**DESCRIPTION:**

Helen - Battle Telecommunications Route  
Microwave Radio And T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

ITEM			QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS						
					FIRST COST		PRESENT WORTH OF FIRST COST		ANNUAL COST		PRESENT WORTH OF ANNUAL COSTS				
					AMOUNT	DATE OF EXPEND.	FACTOR	AMOUNT	PER CENT	AMOUNT	PERIOD	FACTOR	AMOUNT		
Channel Bank Equip	2	6000			12,000	86	1.0								
Channel Units	42	20			10,920	86	1.0								
Total					22,920				22.7	5203	10	6.144		31,966	
Microwave Radio Equip															
Terminal Site Complete	1	135,500			135,500	86	1.0		19.2	30198	10	6.144		185,537	
Remote Repeater	1	286,400			286,400	86	1.0		19.2	62,383	10	6.144		383,281	
Repeater Partial	1	73,400			73,400	86	1.0		19.3	16,662	10	6.144		102,372	
Total					495,300					109,243				671,190	
Deduct for 96 channels	4	9000			(36,000)	86	1.0		22.7	(8,172)	10	6.144		(50,209)	
Grand Total					482,220					106,274				652,947	

# SYNTH

REMARKS:	NON-STANDARD ANNUAL COST PERCENTAGES				
	(1)	(2)	(3)	(4)	(5)
	TYPE OF PLANT				
	C OF M				
	PROPERTY TAX				
	INCOME TAX				
	DEPRECIATION				
	MAINTENANCE				
	TOTAL %				

# ECONOMIC SELECTION STUDY

DESCRIPTION:

Helena - Butte Telecommunications Route  
Microwave Radio Site Unit Costs  
PLAN 2 OF 3 SHEET 2 OF 3  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS				REVENUE REQUIREMENTS			
			FIRST COST	PRESENT WORTH OF FIRST COST	ANNUAL COST	PER CENT	AMOUNT	PERIOD FACTOR	PERCENT	AMOUNT
1 Terminal Site				86	1.0					
2 Digital Microwave Radio	1	54,900				22.7	12,462	10	6.144	75,567
3 Antenna System	1	9,000				22.7	2,043			12,552
4 Battery and Power	1	5,600				22.7	1,271			7,809
5 AC Generator	1	35,000				21.7	7,595			46,664
6 Tower, Stub, 30 Ft.	1	16,000				21.7	3,472			21,332
7 Site Work, Existing Bldg.	1 Lot	5,000				21.7	1,085			6,666
8 Spares, Each Site	1 Lot	10,000				22.7	2,270			13,947
9 Total			135,500				30,198			185,537
10										
11 Remote Repeaters				86	1.0					
12 Spares, Each Site	1 Lot	10,000				22.7	2,270	10	6.144	13,947
13 Digital Microwave Radio	2	50,400				22.7	22,882			140,587
14 Antenna System	2	9,000				22.7	4,086			25,104
15 Battery and Power	1	5,600				22.7	1,271			7,809
16 AC Generator	1	35,000				21.7	7,595			46,664
17 Tower, 150 Ft.	1	62,000				21.7	13,454			82,661
18 Land And Site Work	1	30,000				18.0	5,400			33,178
19 Building	1	25,000				21.7	5,425			33,331
20 Total			286,400				92,383			383,281

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	21.7

# ECONOMIC SELECTION STUDY

### DESCRIPTION:

## Helenz - Butte Telecommunications Route

PLAN 2 OF 3 SHEET 3 OF 3  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

[illegible][illegible]

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

**DESCRIPTION:**

Helena - Butte Telecommunications Route  
T1 Circuits

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

REMARKS: 71 casts for facility, based on  
5 year contact

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

REMARKS: T1 casts for facility, based on  
5-year contact





**SECTION 6**

**HELENA-WARM SPRINGS**

**HELENA-DEER LODGE**

**TELECOMMUNICATIONS ROUTE STUDY**



### Helena-Warm Springs

Inspection of the Helena-Warm Springs route circuit costs reveals that the conventional circuits are priced the same as Helena-Butte circuits. The T1 circuits are slightly more expensive. The microwave route costs would be virtually the same, except for fewer channel units. This means that the cost relationship developed in the study are essentially the same for Helena-Butte and Helena-Warm Springs. Conventional circuits are more economical until the circuit requirement exceeds 16. Combining the Warm Springs and Butte circuits into a large total requirement would not be advantageous because of the significant cost to carry the circuits between Warm Springs and Butte. Combining them on microwave radio would not make the microwave radio plan cost effective because the requirements would still be lower than the prove-in point for microwave. That point would become higher in number of circuits as a result of the cost of the additional equipment required at the last repeater and the added Warm Springs terminal.

### Helena-Deer Lodge

Two plans are compared in the analysis of the Helena-Deer Lodge route: conventional circuits and T1 circuits. Microwave radio is not cost effective for a cross section with circuit requirements of the size encountered on this route.

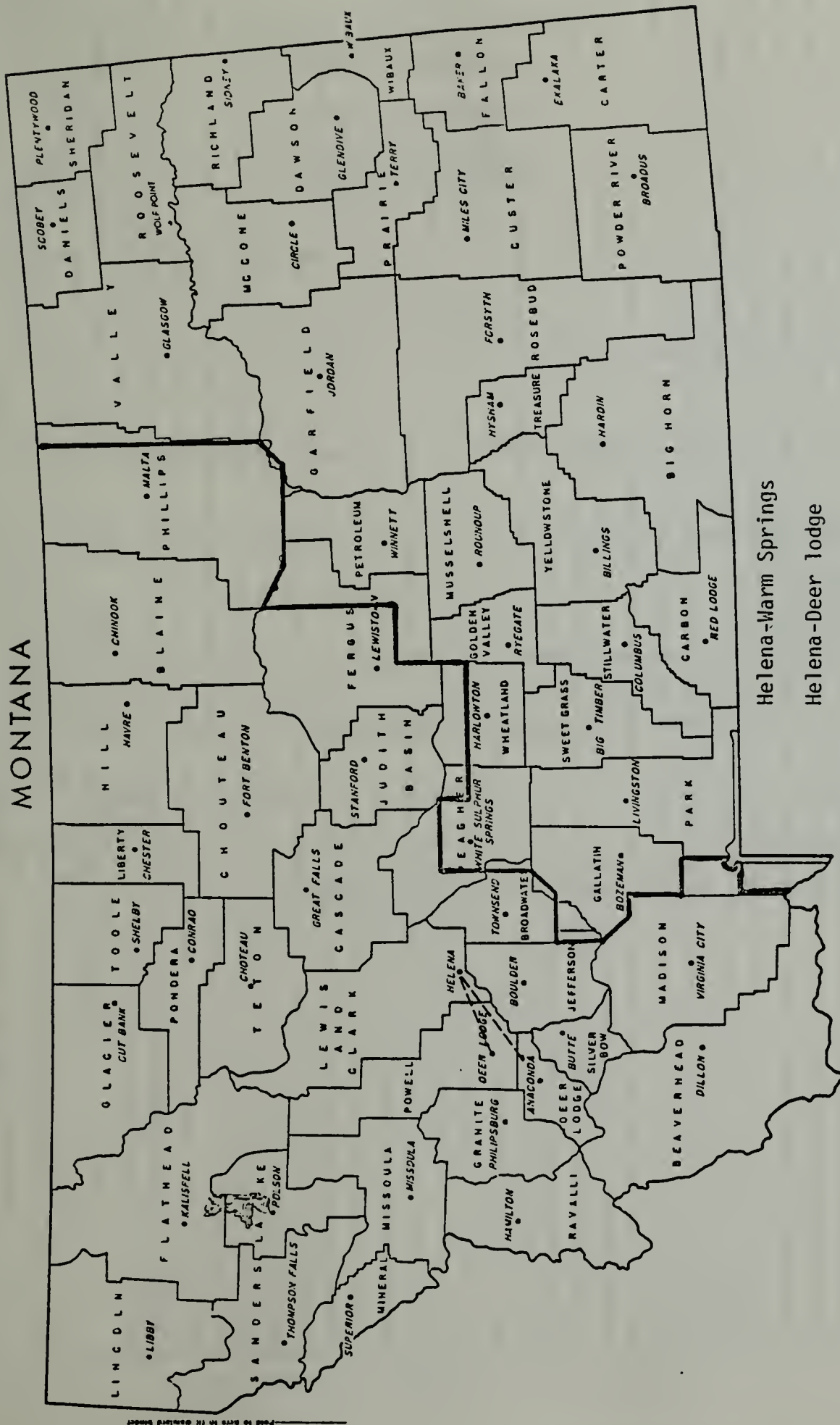
## Summary of Results

### Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 131,658	Conventional circuits
Plan 2	162,258	T1 Circuits

The results indicate that conventional circuits are more cost effective than T1 circuits at the present rates and circuit requirements. As the circuit requirement is lower than the economical minimum for T1 or microwave radio, it is recommended that conventional circuits be retained. If a significant change in circuit costs or the number of circuits required occurs, this route should be re-examined. A requirement for 56 Kbps data would also be cause for re-examining the route. T1 would be more economical than conventional circuits after the 16th circuit.

# MONTANA



• County Seat

-----T1 Route

Helena-Warm Springs

Helena-Deer Lodge

HELENA-WARM SPRINGS

HELENA-DEER LODGE

CIRCUIT REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Helena-Warm Springs, 10 voice	11	11	12	12	13	13
Helena-Deer Lodge, 7 voice, 1 data	9	9	9	10	10	11

5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

Since growth is small, 12 circuits are used to represent the nominal requirement for the study period for Warm Springs, and 10 circuits are used to represent the nominal requirements for Deer Lodge.

**DESCRIPTION:**

PLAN 1 OF 2 SHEET 1 OF 1  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----

[illegible]

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

**DESCRIPTION:**

# T1 Circuits

PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_

## STUDY PERIOD

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20

**REMARKS:**[illegible]





**SECTION 7**

**MISSOULA-KALISPELL**

**TELECOMMUNICATIONS ROUTE STUDY**



Two plans are compared in the analysis of the Missoula-Kalispell route: conventional circuits and T1 circuits. Microwave radio is not cost effective for the number of circuits and the route miles involved.

#### Summary of Results

Present Worth of

	<u>Annual Costs</u>	<u>Description</u>
Plan 1	\$ 333,459	Conventional circuits
Plan 2	284,761	T1 Circuits

The results indicate that T1 circuits are more cost effective over the life of the plan. However, as the present circuit requirement has not reached the break-even point of 17 circuits, no action should be taken at present to change from conventional circuits. An overall increase in requirements, a requirement for 56 Kbps data circuits or an increase in the per-circuit costs of conventional circuits would warrant a re-examination of the route economics.

[illegible]

- County Seat

T1 Route

MISSOULA-KALISPELL ROUTE CIRCUITS REQUIREMENTS

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Missoula-Kalispell, 12 voice, 1 data	14	15	15	16	17	17

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

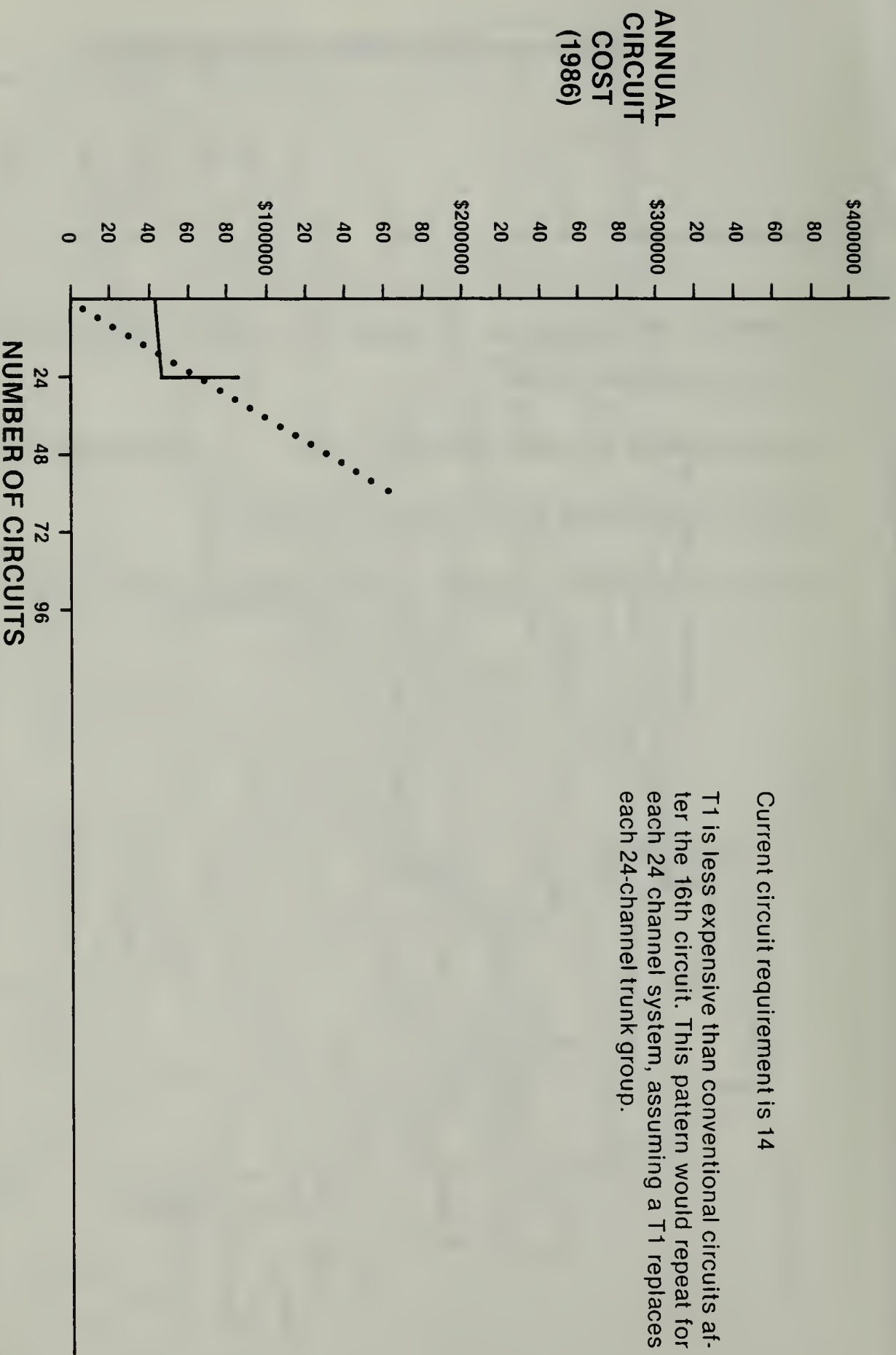
Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per annum.

15 circuits are used to represent the total during the study period.

Current circuit requirement is 14

T1 is less expensive than conventional circuits after the 16th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each 24-channel trunk group.



# MISSOULA — KALISPELL ROUTE

———— T1 Circuits

..... Conventional Circuits

**DESCRIPTION:**

PLAN 1 OF 2 SHEET 1 OF 1  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_

Missoula - Kalispell Telecommunications Route  
Conventional Circuits

STUDY PERIOD

[illegible]

REMARKS:

[illegible]

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----

**DESCRIPTION:**

PLAN 2 OF 2 SHEET 1 OF 1  
PREP. BY \_\_\_\_\_ DATE \_\_\_\_\_  
STUDY PERIOD \_\_\_\_\_

STUDY PERIOD

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

## REMARKS:

### NON-STANDARD ANNUAL COST PERCENTAGES

TYPE OF PLANT	
C OF M	
PROPERTY TAX	
INCOME TAX	
DEPRECIATION	
MAINTENANCE	
TOTAL \$	





**SECTION 8**

**BILLINGS-MILES CITY**

**TELECOMMUNICATIONS ROUTE STUDY**



The Billings-Miles City circuits are priced approximately the same per mile as the Missoula Kalispell circuits as follows:

	5 year	
	<u>T1</u>	<u>Conventional</u>
Missoula-Kalispell	\$34.33/month/mile	\$1.60/month/mile
Billings-Miles City	\$34.45/month/mile	\$1.60/month/mile

Other applicable charges, such as termination and one-time charges, are also the same.

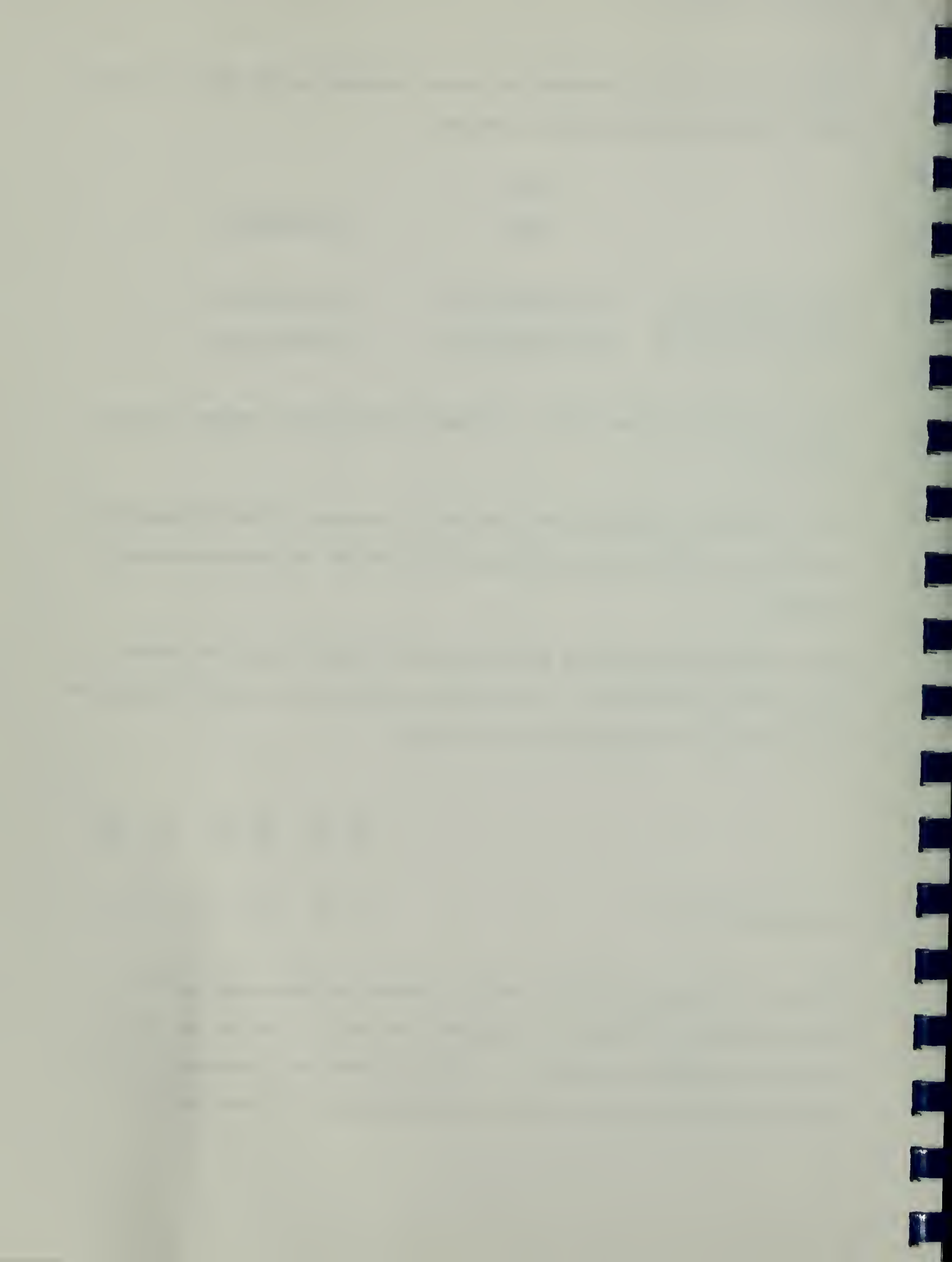
It is concluded, therefore, that the cost relationship for the Billings-Miles City circuits would be nearly identical to those for the Missoula-Kalispell circuits.

The circuit requirements for this route are 10 voice and one data circuit.

Using the 5% addition factor for overflow to discounted toll and increasing at 2% per year, the requirements are as follows:

	<u>86</u>	<u>88</u>	<u>90</u>	<u>92</u>	<u>94</u>	<u>96</u>
Billings-Miles City	12	12	13	13	14	14

The cost relationship indicate that T1 circuits are more economical than conventional circuits when the requirement reaches 17. An increase in the cost of conventional circuits or in the requirements or a requirement for 56 Kbps data circuits would warrant a re-examination of the route economics.







**SECTION 9**

**SATELLITE/EARTH STATION**

**TELECOMMUNICATIONS SYSTEM STUDY, 5 CITIES**



A budgetary proposal was requested for a satellite system to provide the telephone and data circuits between Helena, Billings, Bozeman, Great Falls, Missoula, Kalispell, Havre and Miles City. The costs received were incremental for earth stations on a per-site basis. Budgetary transponder rental costs were also included for estimating system costs.

The plan that is analyzed includes five earth stations and transponder capacity for the traffic generated by Helena, Billings, Bozeman, Great Falls, and Missoula. The results can be compared directly with the combined terrestrial plans for these cities.

The satellite system is not economically competitive with microwave radio or T1 for the applications studied. The satellite system is approximately 12% less expensive than conventional circuits for this application.

Television broadcasting capability could be added at a relatively small cost from one of the earth stations. If this should become a firm requirement at a future date, a satellite system should be re-examined for cost effectiveness at that time.

# ECONOMIC SELECTION STUDY

### DESCRIPTION:

## Satellite / Earth Station System, 5 Cities

PLAN — OF — SWEET — OF —  
PREP. BY h DATE —

STUDY PERIOD 86 - 95 -[illegible]

REMARKS:

7976 of the circuits included in the proposal are served by the 4 stations covered. The transponder cost was reduced accordingly.

Stations were included for direct comparison with the terrestrial plants

NON-STANDARD ANNUAL COST PERCENTAGES					
	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	Same as	Mw Radio			
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION*					
MAINTENANCE					
TOTAL %					





**SECTION 10**

**SMALL EARTH TERMINAL DATA SYSTEMS STUDY**



A budgetary proposal was requested for a small earth terminal data system to serve the 56 county seats. Helena was assumed to be the location for the databases that would be accessed. Helena did not have an earth terminal, but entered the system via a leased telephone line to a master earth station, assumed for pricing purposes be located in California.

The analysis indicates that this is not a cost effective substitute for the existing data systems to the small cities. The monthly cost per terminal would be \$640, if purchased, or \$360, if rented. Additional services such as remote sensing, could be added at the same incremental cost if the system was in place.

If some of the emerging requirements for additional data services develop, this approach should be examined for cost effectiveness and survivability. Examples of new services that might become requirements in the future are access to brands registration information, access to library material, access to land title information, access to location files, transmitting engineering information between a remote construction site and a State headquarters or any low volume, wide-spread requirement for inquiry/response transaction networking.







## SECTION 11

### FIBER OPTIC ROUTE STUDY

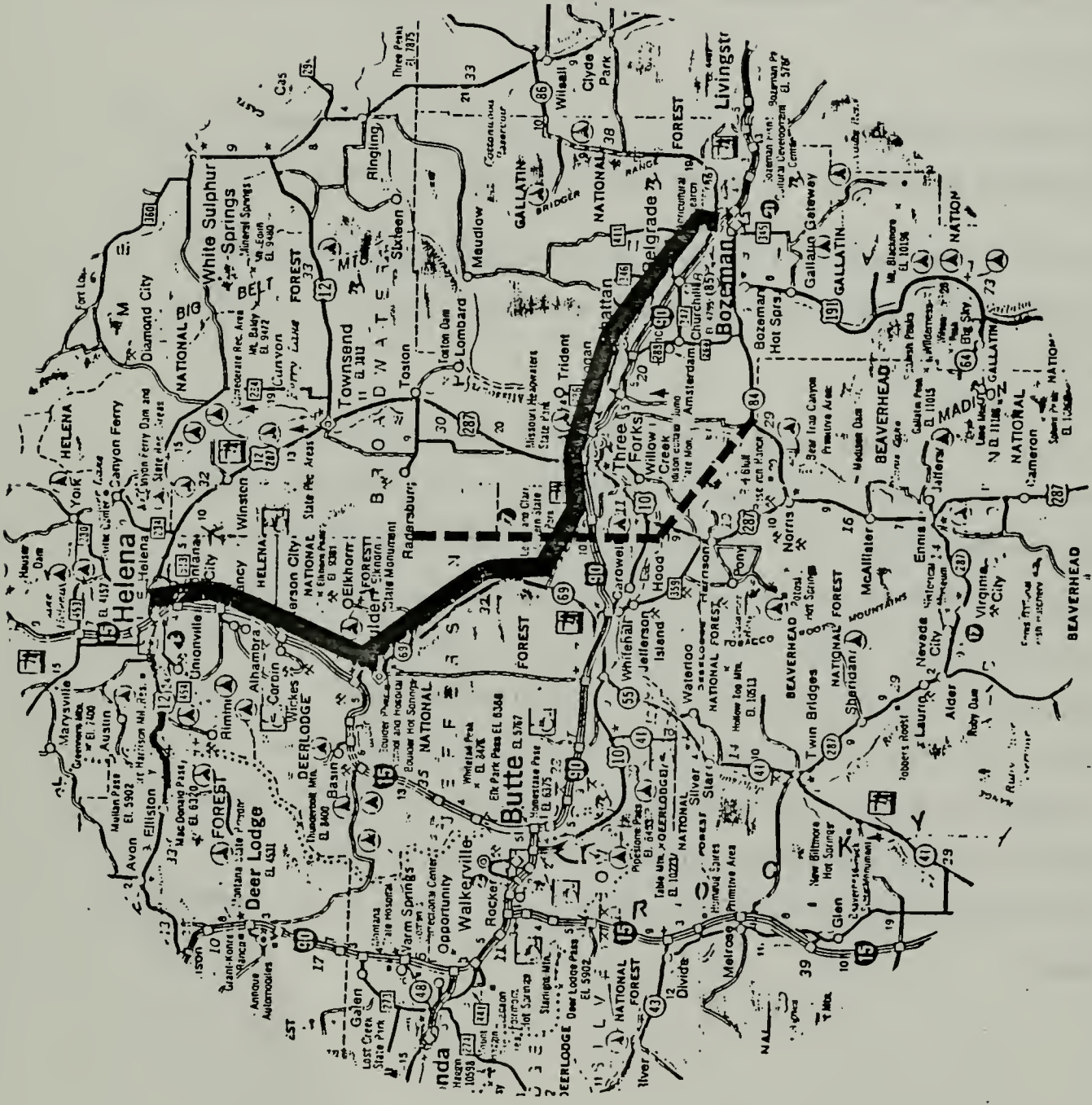


A preliminary cost estimate of a fiber optic system with T1 channel banks was prepared for comparison with the costs of a microwave radio system in the same route. Helena-Bozeman was chosen for the estimate because it has the largest cross section circuit requirement, and therefore fiber optics were most likely to prove in.

The length of the route is approximately 95 miles. It was assumed that right-of-way would be available at no cost along State-owned or -controlled roads.

The total turnkey cost for this route is \$2,362,645. This compares with a microwave radio system of the same installed channel capacity, whose first cost is \$1,218,400.

The fiber optic system can be expanded to 15,000 voice circuits, while the microwave radio system described can be expanded to 192 channels. The fiber optic is cost effective for extremely large circuit requirements or, more accurately, bandwidth requirements, as it can support voice, data, television, or any application that can be converted to light pulses. In particular, the installed cost per circuit of the fully loaded microwave radio system would be \$6,346. The installed cost per circuit of the fiber optic system, when used to support 192 channels, would be \$13,727. However, when fully allocated, the fiber optic system would cost only \$157.50 per installed channel. The breakeven point between fiber optics and microwave occurs at approximately 372 channels.



FIBER OPTIC ROUTE

LATA BOUNDARY

# HELENA-BOZEMAN FIBER OPTIC CABLE

MONTANA DIGITAL NETWORK  
HELENA-BOZEMAN OPTICAL FIBER

---

ROUTE LENGTH	- 95 MILES - 152,888 METERS - 501,600 FEET	
6 OPTICAL FIBERS	- 3 PAIRS	
PRESENT MAXIMUM CAPACITY	- 1000 MBPS - 15,000 VOICE CIRCUITS	
		<u>COSTS</u>
RIGHT OF WAY		\$ NC
ROUTE ENGINEERING - \$.18 x 501,600 FT		90,288
CABLE - \$3.06/METER x 152,888 METERS		467,837
SPLICING AND SUPPLIES		292,600
CONSTRUCTION - 501,600 FT x \$2.00/FT		1,003,200
OPTICAL SYSTEM - 2 TERMINALS		75,000
MULDEMS		23,000
THROUGH REPEATERS - 3		99,500
SUPPORT EQUIPMENT		50,000
OPTICAL SYSTEM INSTALLATION AND TEST		64,000
CHANNEL BANKS - 4 - 1.544 Mbit CAPACITY EACH		64,360
CHANNEL BANKS INSTALLATION AND TEST		12,860
SUPPORT STRUCTURES		120,000
		<hr/>
TOTAL		\$2,362,645







## APPENDIX D

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## **APPENDIX E**

### **GLOSSARY**



## GLOSSARY

### A

A/D	Analog to Digital (conversion)
ADPCM	Adaptive Differential Pulse-Code Modulation
ATT COM	AT&T Communications, formerly Long Lines
ATT IS	AT&T Information Systems, a provider of customer premises equipment

### B

BER	Bit Error Rate
Bit	Basic unit of digital information

### C

CAD/CAM	Computer Aided Drafting/Computer Aided Mapping
CATV	Cable Television
C-Band	4/6 GHz Frequency Band used for Satellite Communications
CCR	Customer Controlled Reconfiguration
CO	Central Office - Switch Center
Channel Banks	Common equipment and individual channel electronic cards used to impress multiple circuit on a transmission facility. See Multiplex.
COAX	Coaxial Cable
CODEC	Coder/Decoder

Conventional Circuit Private line single voice or data circuit provided by a common carrier.

CPE Customer Premises Equipment

CSU Channel Service Unit

CVSD Continuously Variable Slope Delta Modulation

## D

D/A Digital to Analog (conversion)

dB Decibel, unit of relative sound magnitude

DDD Direct Distance Dialing

DEMUX Demultiplexer

DSO Voice Channel or 56 kbps Data Channel

DS-1, DS-2, Frame and Signal Specification for Digital Transmission at

DS-3 & DS-4 1.544, 6.312, 44.736, and 274.176 Mbps, respectively

DSU Data Service Unit

DSX-1 T1 Channel Quality Specification; Pulse Template

DTE Data Terminal Equipment

DTS Digital Termination Service

DTMF Dual Tone Multi-frequency

D1, D1D, D2, Channel Banks for T1 Communications

D3 & D4

## E

ESS Electronic Switching System

## F

FAX	Facsimile
FCC	Federal Communications Commission
FDM	Frequency Division Multiplex
F/O	Fiber Optics, a transmission medium using light to transmit digital signals
FT2, FT3, & FT4	Fiber Optic T-Channel Equivalent Systems (12.624, 44.736, and 274,176 Mbps)

## G

G&A	General and Administrative Expenses
Gbps	Gigabits per second, bits X 10(9)
GHz	Gigahertz, billions of cycles per second

## H

HF	High Frequency
Hz	Hertz, formerly Cycles Per Second

## I

ISDN	Integrated Services Digital Network
------	-------------------------------------

## K

Kbps	Kilobits Per Second, 1000 bits/second
km	Kilometer

Ku-Band      11/14 GHz Frequency Band used for Satellite communications  
\$K      Thousands of Dollars

L

LAN      Local Area Network  
LATA      Local Access and Transport Area  
LNA      Low Noise Amplifier  
LRCC      Local Rate Center Connection  
LSI      Large Scale Integration

M

m      Meter  
Mbps      Megabits per Second    1 million bit/second  
Mhz      Megahertz, millions of cycles per second  
Microwave Radio    A transmission system utilizing radios of 2 GHz and higher  
frequency to provide a carrier for communications circuits  
MODEM      Modulator/Demodulator  
MUX      Multiplexer.    An electronic device for establishing structured  
divisions of a carrier facility so that multiple circuits can be  
carried simultaneously.    May refer to multiple systems, rather  
than multiple individual circuits.  
M24      AT&T Channel Banks - 24 Voice/Data Channels  
M44      AT&T Channel Banks - 44 Voice Channels

N

N/A            Not Available or Not Applicable

O

OCC            Other Common Carrier

OCU            Office Channel Unit

P

PBX, PBX       Private (Automatic) Branch Exchange

PCM            Pulse Code Modulation

R

RBOC           Regional Bell Operating Company

ROW            Right of Way

S

SCPC           Single Channel Per Carrier

T

TDM            Time Division Multiplex

TDMA           Time Division Multiple Access

T1, T1C,       North American Standard Digital Transmission Formats

T2, T3 & T4    (1.544, 3.152, 6.312, 44.736, and 274.176 Mbps)

U

UHF            Ultra High Frequency

V

VF            Voice Frequency

VHF           Very High Frequency



